SCIENCE

NOVEMBER 16, 1951

VOLUME 114 NUMBER 2968

Contents

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Prosser, Brown, Bishop, Jahn & Wulff's

COMPARATIVE ANIMAL PHYSIOLOGY

"It is evident that the authors have expended much effort to accomplish a greatly needed and worthwhile task, with extremely gratifying results. . . . This book is heartily recommended as the best text available in its field to date. To no less an extent is it a valuable reference work." —*Scientific Monthly*

Edited by C. LADD PROSSER. By FRANK A. BROWN, JR., Professor of Biology, Northwestern University; DAVID W. BISHOP, Professor of Physiology, University of Massachusetts; THEODORE L. JAHN, Professor of Zoology, University of California at Los Angeles; C. LADD PROSSER, Professor of Physiology, University of Illinois; and VERNER J. WULFF, Assistant Professor of Physiology, University of Illinois. 888 pages, 6" × 9", with 312 illustrations. $13.00.

W. B. SAUNDERS COMPANY

West Washington Square — Philadelphia 5

Alaskan Agriculture

IN RECENT years the United States has become impressed with the strategic importance of Alaska and its vulnerability to attack. In the past the Territory has produced only a small proportion of its food, although extensive areas of potential agricultural land are available. Since 1946 the federal government has been cooperating in an effort to make the Territory more nearly self-sufficient in the food supply for its population, which has increased from 72,524 in 1939 to 126,661 in 1950.

Progress has been retarded by the unusual features of the soils and climate of this subarctic region, the short summer with nearly 24 hours of daylight, and the severe, prolonged winters. As a foundation for increasing production under these conditions, the Alaska Agricultural Experiment Station has been expanded since 1947. New facilities have been constructed, and a competent staff has been employed. The experimental work, carried on as a joint undertaking by the U. S. Department of Agriculture and the University of Alaska, is designed to develop crop varieties, cultural methods, and livestock enterprises adapted to Alaska.

Recent experiments show that fertilizers are absolutely essential for efficient food production. Because of the high costs of labor and land-clearing, potato farmers can profitably use 800–1,000 pounds per acre of concentrated fertilizers. Dairy farmers can lower feed costs by one half and raise 50–100% more feed by following fertilizer recommendations developed in the past three years.

Potato breeding and variety testing are in progress to develop or select a potato that produces a heavy yield of firm-skinned, uniform U. S. No. 1 tubers, with shallow eyes and good cooking qualities. In variety yield trials, ten new selections, chosen from over 8,000 seedlings, have proved superior to any of the named varieties in eye depth, smoothness of skin, and productivity.

Vegetable varieties and bush and tree fruits are being tested on an extensive scale, to select the best commercial varieties based on their adaptation to various types of soils and their resistance to disease and insect pests. Winter hardiness of perennials is also being tested.

Bulls of the Red Dane breed have been introduced into Alaska and have been bred with Guernsey cows. Heifers from these matings are now calving and promise to be good milk producers. Also, 560 cows were artificially bred last year.

Research has shown that roughage can be processed as silage more cheaply than as field-cured hay, with much smaller losses. Most dairymen now depend mainly on silage for winter feed, for it takes 25–40% less acreage to feed a cow all winter on silage than on field-cured hay.

More complete cost and income data are being widely distributed among Alaska farmers. Information on markets for farm produce, their location, total market outlets, and consumer preferences is assisting in increasing consumption of Alaska products, thus reducing imports and making shipping space available for military equipment and supplies.

The primary objectives of agronomic investigations are to develop superior varieties of forage and cereal crops and to determine the most profitable methods of producing them. Forage species and varieties from various parts of the world are under test. Work begun in 1948 resulted in release of two superior cereal varieties selected by the Station—Golden Rain oats and Edda barley—to Alaskan farmers in the spring of 1951. A red clover variety and a yellow-flowered alfalfa, now under cultivation in the state of Washington, should be ready for distribution to Alaskan farmers by 1952 and 1953.

Although Alaska has been producing only about one sixth of the food it consumes, this can be increased to perhaps three fourths of its needs when more land is cleared and answers are found for the unusual technical agricultural problems.

DON L. IRWIN
Alaska Agricultural Experiment Station

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

All correspondence should be sent to SCIENCE, 1515 Massachusetts Ave., N.W., Washington 5, D. C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY. Subscription and advertising rates on request.

Old customs die hard. Many lecturers still seem to think they must stand before the screen and wave a wand.

That's outmoded . . . passé . . . inefficient, since Beseler put the POINTEX† PROJECTION POINTER on the VU-LYTE. Now the speaker stays behind the projector, views an undistorted picture just as the audience sees it, and points out details by a moving arrow of light. A convenient control knob at the front of the projector enables the speaker to direct the arrow anywhere on the screen just exactly where he wants it.

This patented POINTEX† PROJECTION POINTER is only one of many of VU-LYTE's novel features directly devised to meet the modern needs of visual education teachers and lecturers.

Because VU-LYTE is replete with tested innovations to make both lecturing and viewing easier, it is the unrivalled leader for opaque projection in schools, churches, clubs, and business.

1. YOU CAN use the VU-LYTE in a partially lighted room. Total darkness is not necessary in order to obtain clear, sharp images and brilliant colors—because VU-LYTE provides *extra* illumination.

2. YOU CAN feed mixed or continuous copy through smoothly, without light flashes, by means of the Beseler FEED-O-MATIC° METAL BELT CONVEYOR. As new copy is fed in at the left side of the projector, preceding copy is ejected from the right side.

3. YOU CAN use copy "as is"—without mounting or inserting into any special holding device. The unique Beseler VACUMATIC° PLATEN holds all copy *absolutely flat* during projection. A full 8½ x 11 page letter or a postage stamp can be projected with equal ease, without curl or flutter.

4. YOU CAN use VU-LYTE on an uneven surface—project on small or large screens. In addition, VU-LYTE is an amazingly quiet and cool-operating opaque projector.

°Pat. Pending
†Patented

These advanced, exclusive features, plus others, are incorporated in a projector that weighs only 35 lbs. and is REDUCED IN PRICE. Ask for free demonstration of the precision-built VU-LYTE in your own projection room. And for more information regarding this truly new concept in opaque projection, ask for booklet

CHARLES Beseler COMPANY
EST. 1868
60 Badger Avenue, Newark 8, N. J.
The World's Largest Manufacturer of Opaque Projection Equipment

Medical Research and Medical Education[1]

Leonard A. Scheele and W. H. Sebrell

Public Health Service and *National Institutes of Health, Washington, D. C.*

WHEN VANNEVAR BUSH'S IMAGINATIVE AND PRODUCTIVE REPORT to the President, *Science the Endless Frontier,* was issued in 1945, the major problems facing science in this country appeared to be expansion of support for research, particularly basic research, and the development of scientific talent in the youth of the country. Since then, the increase in funds available for research from both private and public agencies has been rapid. Money from both sources is now available for most fields on a scale that would have seemed visionary in 1945. With reference to federal funds for basic research and for fellowships in medicine, for example, Dr. Bush's report said, "After a program is under way perhaps 20 million dollars a year can be spent effectively." The U. S. Public Health Service alone supported medical research and fellowships in medical schools, universities, and other institutions at a level of about $18,000,000 in 1951.

Even though most areas of basic research could productively absorb larger funds, and although some fields of basic science are still meagerly supported, problems other than assurance of financial aid are becoming increasingly acute.

In the field of medical research, it appears to the Public Health Service that the major questions at this time relate, not so much to means of providing funds as to the development of policies ensuring that the objective for which federal funds are made available—promotion of basic research in medicine—is achieved most effectively. These policies must also ensure that the most productive relationship between medical research and medical education is established.

The Public Health Service is keenly aware that the research grants it is distributing to investigators in medical schools have a direct bearing upon the productivity of the nation's medical research program. Moreover, the grants have both direct and indirect effects upon the teaching function of the schools. Teaching is the major function of medical schools. For this reason, any activity of the Public Health Service—including provision of funds for research—affecting the performance of the teaching function must be most carefully considered to determine whether it affects teaching adversely or favorably.

Concern expressed by our advisers over the total effect of the grants for which we are responsible led us, in 1948, to request a group of outstanding men to assess just what these grants were accomplishing, and what problems they were creating. The group was known as the Surgeon General's Committee on Medical School Grants and Finances. Under the chairmanship of Lowell Reed,[2] vice president of The Johns Hopkins University, the committee produced a thorough report on the financial status of medical schools and on the relationship of federal research grants to the functioning of medical schools.[3] Most of the facts that we shall cite were unearthed by this committee, and many of the general considerations of policy subsequently discussed are the outgrowth of problems identified by the group.

One problem that merits the closest consideration is the effect on science of large-scale research in medicine and related fields—and the relationship of the federal government to the recent expansion of large-scale research. We are fully aware of a sharp cleavage of opinion in scientific circles on the degree to which research can or should be planned, set within a program, and be carried on by organized groups.

Dr. Conant, president of Harvard University, has succinctly phrased the essence of this debate: "The more uncommitted investigators the better . . .;" [however], "forces tend to increase the emphasis on programmatic research. . . . But if it be true, as I believe history shows, that the significant revolutions, the germinal ideas, have come from the uncommitted investigator, then the present trend holds grave dangers for the future of science in the United States."[4]

Dr. Bronk, president of The Johns Hopkins University, has said, "There is a grave danger that the present demand by publicists, industrialists, and public administrators for large-scale scientific organization may impede progress."[5]

Few thoughtful persons will deny that the dangers are real. The Public Health Service is, we repeat, directly and deeply involved in these matters, as are all private and public agencies now supplying funds for medical research.

Do our activities, by increasing the funds available for medical research, lead to excessive gadgeteering? Do they lead to a situation in which the nation has too few "uncommitted" investigators? Is it possible that the grants we administer create a threat to the freedom of science? We would like to present a point

[1] Based on an address by Dr. Scheele at ceremonies commemorating the one hundredth year of continuous medical education in Tennessee, University of Tennessee College of Medicine, Memphis, Oct. 4, 1951.

[2] The members of the committee were: George Baehr, Robin C. Buerki, Edward A. Doisy, R. G. Gustavson, Algo D. Henderson, E. E. Irons, Carlyle Jacobsen, Hugh J. Morgan, B. O. Raulston, James S. Simmons, and Herman B. Wells.

[3] *Medical School Grants and Finances, A Report by the Surgeon General's Committee on Medical School Grants and Finances.* Washington, D. C.: Public Health Service Publication No. 53, G.P.O. (1951).

[4] Conant, J. B. *Science and Common Sense.* New Haven: Yale Univ. Press, 320 (1951).

[5] Bronk, D. W. *Science,* **109**, 477 (1949).

of view on these questions based, first, upon our concept of the relationship of the Public Health Service to medical research in medical schools and universities and, second, upon our experience and study.

In our opinion, it is a mistake to assume that the pressure for large-scale medical research is the direct result of the large amounts of money now available. If there is undue emphasis in this country upon large-scale, programmed research, it is the result of intellectual forces that stem from society and from the scientific world itself.

This trend arises in part out of changes in the characteristics of research. The exploration of the underlying physical, chemical, and electrical characteristics of protoplasm and of biological systems is perhaps the most significant movement in medical research in this country. These investigations commonly require the combined talents of people trained in diverse disciplines. They usually require a degree of precision in observation and measurement that can be secured only by the use of complicated instruments. In addition, experience during World War II and since has shown that a concerted, planned attack on some problems produces valid results in a shorter period of time than could be expected from the uncoordinated efforts of individuals. All these forces have combined to enhance the magnitude of many investigations.

One cannot, however, remain blind to the possibility that data collection can supplant creative thinking, that some investigators may be intrigued by size itself. It is possible that the major syntheses of thought required for striking advances in science will occur less frequently if too many competent investigators are involved in coordinated research.

We are firmly convinced that the Public Health Service—or the federal government—should not attempt to set any general policy on this issue. Rather, we must allow the scientific community to decide, on the merits of each case, who and what should be supported, and the extent and nature of the coordination—if any—appropriate to each case. Any other stand by the Public Health Service would constitute a real and major invasion of the freedom of research.

We do believe that continuing expansion of medical research, including manpower and facilities for research, is in the national interest, and that the nature, approach, and organization of the expanded effort should be determined by a consensus of competent scientists. How far medical research should be expanded in relation to other fields is not a matter that we are competent to judge. The formulation of basic policy on the proper size of the nation's total research effort and on the proper division of emphasis by fields seems to us to be a long-range function of such bodies as the National Science Foundation.

What, then, is the role of the Public Health Service?

Its role is, in our view, to establish and maintain a mechanism which ensures that decisions truly reflect the collective judgments of those concerned with medical research and medical education. In this way, we intend to maximize the freedom of individual scientists to choose the extent to which they will be committed. This mechanism is a structure of eighteen technical panels, each composed of about twelve specialists selected from outstanding investigators in medical schools and universities. These panels are called "Study Sections." Their function is to review grant applications from prospective investigators.

The recommendations of Study Sections are reviewed by one of seven National Advisory Councils. The Study Sections have been set up administratively, but the councils are statutory bodies, and they include representatives of the general public, as well as scientific members. These groups not only review grant applications but also advise the Public Health Service on questions of general policy.

Errors in major scientific strategy—such as, for example, promoting a degree of large-scale research not in the best interest of scientific progress—can be committed by people of narrow vision, or by people who are unconsciously prejudiced by their own scientific or personal interests. This danger we seek to avoid through rotation of membership on our advisory bodies and by a most careful and discriminating selection of members. We believe that our councils and our Study Section groups are broadly representative, competent, and open-minded—so far as these virtues can be possessed by a group of human beings.

The origin of the research proposals considered by these advisory groups is of the utmost significance in any general assessment of the role of the Public Health Service. Subjects for investigation and the general scope and nature of the experimental approach are, with rare exceptions, set by individual scientists or by their institutions.

Although the Public Health Service only occasionally suggests areas for study, we believe that we have a positive responsibility to stimulate and even to plan investigations in particular circumstances. A Public Health Service investigator, for example, found that penicillin was extremely effective in the treatment of syphilis. We then stimulated a large-scale, controlled experiment involving a number of universities and medical schools. Clinical tests were designed to determine the most effective size and timing of dose. Within a short time, answers were produced that would have been available only over a period of years if the task had been left to the uncoordinated efforts of individual investigators. The same procedure was followed in the case of a coordinated study of the efficacy of streptomycin in the treatment of tuberculosis. To take another example, we have supported widespread studies of cortisone and other steroids. A similar large-scale coordinated research program on blood and plasma volume extenders is now in progress. These undertakings are typically financed by special Congressional appropriations, and not by contracting the scale of basic research support.

Coordinated studies are discussed with the appropriate National Advisory Councils, and one of the councils must, by law, recommend these grants, as is

true of all research grants, before they can be approved by the Surgeon General.

Whenever circumstances warrant, we shall undoubtedly launch large-scale research programs and persuade investigators to take part in them. As has been true in the past, however, they will remain a relatively small part of the total program. Studies such as these are largely applied research, and some of them do commit investigators to a definite research procedure. In our judgment, however, they are clearly in the national interest, and the medical research potential of the nation should be adequate to encompass them, as well as fundamental research by uncommitted investigators.

Most of our research grants have been made within the framework of Congressional appropriations for broad disease categories, such as cancer, heart, and mental health. Under such a system, it is conceivable that only applied investigations specifically and demonstrably related to specific diseases would be supported by the Public Health Service. However, we and our advisers are convinced that, if this philosophy were to prevail, the basic phenomena which will explain these diseases would elude discovery. For this reason we encourage the widest range of basic investigation. There is virtually no aspect of fundamental medical research that is not being supported by Public Health Service research grants, and such studies comprise the bulk of the work supported.

In this connection, we have urged that studies relating to narrowly defined diseases or disease groups not be set apart for support through institutes with narrow missions, but rather that they be grouped so that undue emphasis upon applied research can be avoided. Congress has accepted the principle that medical research cannot be best advanced by setting up small research compartments.

The form in which our research grants are made, as well as the total volume of grants and the general fields that they cover, affects investigators. Our grants are for research projects—for investigations outlined in advance by the experimenter. There are, of course, certain risks in such a system.

First, inadequate attention to the capability of the investigator—as contrasted with the outline of work that he proposes to undertake—can lead to serious errors. Our advisers do give the qualifications of the applicant, whether he is a recent graduate or a seasoned investigator, heaviest weight in arriving at decisions. In our opinion this is the only sound policy to follow.

A second potential danger inherent in any project grant system is that the grant may be administered so that the investigator may feel restricted in formulating and following his project. We do not require that investigators follow in detail the work outlined in their project applications. In practice, we believe that those whose work we help support do in fact have adequate elbow room to follow leads and hunches.

A third aspect of the project system is the tendency to remove elements of scientific decisions from the medical school and university, and to reduce the flexibility of the institution's research program. This is without doubt one result of any project system of awarding grants, whether the source of the funds is governmental or private.

A fourth criticism of the project system is that it does not provide adequate continuity of support. Uncertainty seems to be characteristic of life, but our effort is to ensure the maximum continuity of support attainable under annual Congressional appropriations, and consistent with other important but conflicting objectives of a grant program. We feel, for example, an obligation to remain constantly aware of the fact that overemphasis upon continuity can preclude support of some new ideas and of some younger and promising investigators. At present, about 40 per cent of the Public Health Service research grant funds are going to investigators whose work has been continuously supported for three to six years. Whether that percentage should be increased, decreased, or left unchanged is a question that we and our advisers keep constantly in mind.

The Public Health Service, since the inception of its large-scale research grant activities in 1946, has considered solving these four problems by shifting from project grants for individual investigators to a system of block grants for institutions, for departments in institutions, or for broad research programs. There is a great deal to be said for a system that permits medical schools and universities to use the money to support a total research program framed and planned on a long-range basis by the institution itself.

This is a matter, however, on which sharp division of opinion is encountered. Many investigators and some deans of medical schools feel that recommendations as to support of individual investigators made by Public Health Service Study Sections, and similar public and private groups, are sounder than those that might be made within their individual institutions. Many administrative officials prefer to have decisions on research support made outside their own institutions. The formulation of criteria that will provide a guide to the most equitable and productive distribution of block grants to institutions presents a set of thorny and unresolved problems. As a public agency we would hesitate, for example, to establish a system under which we would have to select a few institutions for block grants. On the other hand, if block grants were made to all medical schools, universities, and research institutes, the grant to each would be quite small.

In view of the divergence of opinion, we have asked a group composed of representatives of each of the advisory councils to study the question and to make recommendations to us. At the same time, the Public Health Service staff is gathering an extensive body of fact and opinion, analyzing the information, and reviewing the basic elements of policy that have to be considered in arriving at a decision. This procedure is time-consuming, but we feel that questions

of this nature can be soundly resolved only through broad participation of people with varying viewpoints.

The impact of our research grants on research is no more important than their effect upon the teaching function in medical schools. The dependence of a fully productive teaching program upon adequate links to research is axiomatic. In years past, the establishment of modest research opportunities for faculty members was a major problem. Now the concern is reversed. Many deans worry about ways and means of sustaining a modest amount of teaching of reasonable quality in the presence of a large and growing research structure.

Two basic facts reveal the source of this concern. Since 1941 the basic operating expenditures of medical schools have just about doubled. These are the funds from which salaries are paid, from which equipment and supplies are purchased, and through which buildings and equipment are maintained. They do not include capital expenditures. When account is taken of the sharp price increases over the past ten years, the actual purchasing power of the general operating funds has expanded quite modestly.

On the other hand, research funds have increased more than fourfold since 1941. Even when 1951 dollars are considered in terms of 1941 purchasing power, the scale of research in medical schools has expanded tremendously since the beginning of World War II. The relatively large increase in research funds from both private and governmental sources can be attributed to the postwar upsurge of interest in all research by the general public, and particularly to the drama and appeal of medical investigations. The financial plight of medical schools and the relationship between protection of health and the adequacy of support of the schools have recently had an encouraging result; nevertheless, the failure of the less glamorous teaching function to attract adequate support has created some very real problems, which may be briefly reviewed.

When a medical school accepts a research grant, it incurs costs additional to the direct costs of the research project itself. The school must supply utilities to the laboratory where the project is carried on. It must provide library service to those engaged in the project. It must maintain grounds and buildings. The Public Health Service allows an additional sum—8 per cent—of each project grant for these indirect costs. With rare exceptions, this is not enough. We have not, however, seen our way clear to expand indirect payments at the expense of payment of direct costs; and without larger appropriations from Congress additional payments for indirect costs would result in the denial of grants to investigators in some institutions. We feel that some universities and medical schools are prompted to request the Public Health Service to bear the full direct and indirect costs of research not because they consider this a sound relationship, but because they are now operating under extreme financial pressure.

Large research grants have a direct effect upon the staffing of medical schools and upon salary structures. It should be noted that the Public Health Service makes grants to support not only research, but teaching related to cancer, mental health, and heart disease. These teaching grants have proved extremely valuable but, all things considered, these advantages are obtained at a substantial cost, because some schools have had to employ additional faculty members to carry the teaching load as research has expanded. Moreover, the grants have exerted indirect upward pressure on the general salary structure. In the words of the committee that reviewed the effect of the grants, "The problem is that the schools are hard put to finance these desirable changes, which are in effect forced upon them by the grants."

In the long run a sound teaching structure in medical schools, in our opinion, can be established only by a marked increase in general operating funds and not by proliferation of teaching programs directed toward specific diseases.

A third major effect of increased support of research has been to stimulate the development of new administrative arrangements for the conduct of research. Some of these involve the creation of research institutes or similar organizations that do not follow the traditional pattern of attachment to either the medical school or university science departments. Others involve less formal grouping of research organizations around individuals. In many respects these new patterns seem to be an adaptation to the changing nature and needs of medical research and are productive. Such adjustments suggest that the full volume of medical research performed in universities and medical schools cannot always be accommodated as an enterprise that is directly linked to the teaching function, or otherwise fully integrated with the medical school structure.

One cannot foresee what patterns of organization for medical research will evolve, nor what kinds of relationships may develop between medical research and medical education. There are, however, unmistakable signs that the process of transition is painful. For example, some investigators attached to semiautonomous medical research organizations have no university tenure, and hence lack the degree of security conducive to long-range research productivity. Tenure for these investigators would require financial commitments that many schools cannot undertake because the general financial resources of medical schools are inadequate.

In short, we attribute much of the stress and strain that appears to arise out of the administration of the Public Health Service grant programs to a deficiency in financial resources. In itself, the expansion of medical research has been a clear gain to the nation. Hence we believe that the problems created by uneven growth of research as compared with general support should be resolved by expansion of resources and not by curtailment of research.

The relationship of research to higher education is

not, of course, a problem peculiar to medical research. The vast expenditures on basic and applied research and on development by the armed forces and the Atomic Energy Commission are critically important to the nation's defense. The effect of this accelerated program will permeate the entire structure of higher education. Universities and colleges will be feeling the same financial pinch that medical schools have lived with for some time. It seems quite likely, therefore, that the balance between research and teaching will be a matter of increasing concern. A continuing reappraisal of the net effect of expanded research upon the teaching function, and of the steps required to sustain the quality of both, is urgently needed. We, as well as other agencies, need the guidance of the National Science Foundation and other qualified organizations.

We have explored only a few of the questions of policy that confront us. We have not, for example, been able to explain the Public Health Service research fellowships. In our view, expansion of the pool of highly trained research manpower is as important as the support of work in progress. We believe that the 1,400 fellows whom we have aided to date will, within a few years, contribute significantly to the furtherance of medical research and teaching.

By discussing some specific questions we have tried to indicate what we believe our role to be and how we propose to carry that role out. Underlying all the specific problems is a sense of living and working in an era of transition to patterns that cannot now be foreseen, but which will be different from those of the prewar years. As this evolutionary process moves forward, we are deeply conscious of our responsibilities as public servants. We must keep open the channels of communication between educational institutions and the Public Health Service, and we must formulate our policies on the basis of the most sensitive and intelligent appraisal of trends in medical research and education of which we are capable.

Although we have dealt primarily with unresolved problems, they should not obscure the far more important fact that medical research is advancing rapidly. We believe, indeed, that the medical research of the country is now as alive, intellectually vigorous, and productive as in any period of our history.

Technical Papers

The Effect of Temperature on the Molluscacidal Activity of Copper Sulfate

Donald O. Hoffman and Rizkalla Zakhary[1]

United States Naval Medical Research Unit No. 3, Cairo, Egypt

In recommending copper sulfate as a molluscacide, Chandler (*1*) states:

> There are a number of factors which influence the effect of copper sulfate on organisms in water, the most important being temperature, presence of algae, alkalinity, and organic matter in solution. As regards temperature, no extended experiments were carried out, but experiments with a 1 to 1,000,000 solution were carried out at temperatures of from 15 to 27° C, and the snails apparently succumbed as quickly at the lower as at the higher temperature.

The contradictory nature of these two statements regarding the effect of temperature has never been satisfactorily resolved. It is the purpose of the present study to show that the first of Chandler's statements rather than the second is correct insofar as the effect of temperature on the molluscacidal activity of copper sulfate is concerned.

Observations by other workers as to the bearing of temperature on the activity of molluscacides have been infrequent and inconclusive (*2, 3*). More recent work by Kuntz and Wells (*4*) and by the present authors has led to the conclusion that temperature is a factor of primary importance in determining the activity of molluscacides.

In the present series of experiments the response of *Biomphalaria boissyi*[2] was observed at five temperatures in the range 14°–26° C, using concentrations of copper sulfate pentahydrate varying from 0.05 to 100 ppm. The selected temperature range approximates the seasonal variation in water temperatures in Egypt (*5*).

Snails for these tests were collected from an irrigation drain near Cairo. The collections and tests were carried out between Feb. 24 and May 18, 1951. Four hundred selected snails measuring from 9–14 mm in diameter and weighing 200–350 mg were kept for 48 hr in a battery of four 15-liter aquaria, which, in turn, were surrounded by a water bath maintained at 25 ± 0.5°. Oxygenated tap water was circulated through each aquarium at the rate of approximately 100 ml/min; an excess of a local variety of spinach (*sabaneh*) was also supplied. Continuous illumination was furnished by two 15-w daylight lamps suspended 10 in. above the aquaria. Snails that had undergone this conditioning treatment appeared to give a more nearly uniform response than those used immediately after collection.

Samples of water from local canals and drains har-

[1] The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

[2] The intermediate host of Egyptian *Schistosoma mansoni*.

boring abundant snail colonies showed pH values ranging from 7.3 to 8.5. Molluscacide solutions were made up in distilled water (pH 6.3 ± 0.2), since solutions of copper sulfate in tap water were found to be unstable, principally because of the precipitation action of dissolved carbonate. The copper sulfate solutions used in these experiments varied in pH somewhat irregularly from 5.7 ($CuSO_4 \cdot 5H_2O = 40$ ppm) to 6.8 ($CuSO_4 \cdot 5H_2O = 0.07$ ppm). The pH values were always higher following the 24-hr period during which the snails were in contact with the copper sulfate; these postexposure values ranged from 6.4 to 7.4.

For estimation of the LD_{50} at a given temperature, a series of 4 tests, each at 7 to 9 different copper sulfate concentrations, was carried out. Limitations of space in the constant-temperature bath[3] made it necessary to carry out most of the tests on separate days. For a given test, 16 conditioned snails were placed in each of a series of 1-liter beakers containing 800 ml of aqueous copper sulfate. A band of adhesive tape[4] effectively prevented the snails' escape from the molluscacide solution. For tests at temperatures below 25°, the snails and molluscacide solutions were cooled to the temperature in question before being brought together. After 24 hr at the test temperature the snails were rinsed well in tap water, and the copper sulfate solution was replaced by oxygenated tap water (pH 7.8 ± 0.2), wherein the snails remained for an additional 24 hr at the test temperature.

After rinsing in tap water, those snails that appeared to be alive were placed in a beaker (*L*) containing 300 ml of oxygenated tap water and a few sprigs of pond weed (*Potamogeton*). The snails that appeared to be dead were put in a similar beaker (*D*), after which the beakers were placed under a daylight lamp in a constant-temperature bath of 25°. Twenty-four hr later any living snails in beaker *D* were transferred to beaker *L*, and any dead snails in beaker *L* were put in beaker *D*. All snails were then rinsed well, transferred to fresh oxygenated tap water and returned to the constant-temperature bath for an additional 24 hr. Changes in the number of living and dead snails following such a 48-hr observation period were small. In one experiment involving 288 snails the observation period was extended to 96 hr. The number of snails considered to be dead at the beginning of the observation period (*P*) and at successive 24-hr intervals was as follows: *P*, 171; $P+24$, 180; $P+48$, 182; $P+72$, 182; $P+96$, 183.

In order to ascertain the range of temperatures in which death might occur even in the absence of copper sulfate, a series of control studies, each involving 100 snails, was carried out under the same conditions as those in which copper sulfate was employed—i.e., 48 hr at the test temperature followed by 48 hr (observation period) at 25°. The percentage mortality found was as follows: 26°, 0%; 29°, 13%; 32°, 45%; 35°, 59%; 38°, 100%.

[3] The water bath of a modified Aminco Climatizer.

[4] Bauer & Black Industrial Tape No. 803Y214.

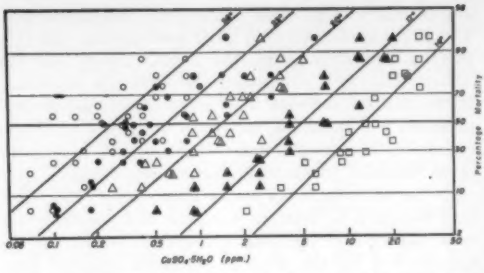


FIG. 1. Response of *B. boissyi* to copper sulfate as a function of temperature.

The response of *B. boissyi* to copper sulfate at the several temperatures and under the conditions described above is shown in the form of a scatter diagram (Fig. 1) in which concentration of copper sulfate is plotted against percentage mortality[5] on logarithmic probability paper (*6*). An over-all linear regression is evident, although from test to test there is considerable variation in response at a given dosage level, particularly at the higher temperatures. Because of the considerable heterogeneity just referred to, estimates of confidence limits and of the slope of the dosage response curve have been reserved for future tests of improved experimental design. It is nevertheless clear that the LD_{50} decreases sharply with increasing temperature, showing approximately a fiftyfold variation over the 12-degree temperature range investigated. The estimated LD_{50} values are as follows: 14°, 13 ppm; 17°, 4.8 ppm; 20°, 1.4 ppm; 23°, 0.58 ppm; 26°, 0.25 ppm.

When the logarithm of the LD_{50} is plotted against the reciprocal of the absolute temperature a straight line is obtained (Fig. 2). From a comparison of this curve with the Arrhenius plot obtained by von Brand, Nolan, and Mann (*7*) for variations in the oxygen consumption of *Australorbis glabratus* with temperature it is evident that, within the temperature range common to both studies, LD_{50} (*B. boissyi* vs. copper

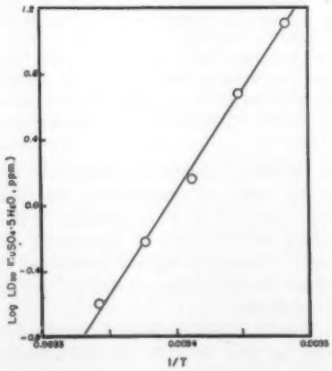


FIG. 2. LD_{50} (*B. boissyi* vs. copper sulfate) as a function of temperature.

[5] Zero and 100% effects have not been plotted.

sulfate) is inversely proportional approximately to the cube of the oxygen consumption rate (*A. glabratus*). Some justification for comparing the LD_{50} of one genus of snails with the oxygen consumption rate of another is found in the fact that the oxygen consumption curve corresponds closely with the normal curve which Krogh (*8*) found to be valid for a wide variety of cold-blooded animals.

In view of (*a*) the prevalence of bilharziasis (*9*), (*b*) the fact that copper sulfate is currently the only chemical in large-scale use as a molluscacide,[6] and (*c*) the fact that the number of snails in a given canal, as estimated by the use of dip nets or palm-leaf traps, may decrease as much as 80% during the hot summer months without *any* external treatment (*10, 11*), the importance of temperature as a factor in snail control work can scarcely be overemphasized.

References

1. CHANDLER, A. C. *J. Agr. Research*, **20**, 193 (1920).
2. NOLAND, M. O., and BERRY, E. G. *U. S. Pub. Health Service Pub. Health Repts.*, **64**, 947 (1949).
3. KUNTZ, R. E., and STIREWALT, M. A. *Proc. Helminthol. Soc. Wash., D. C.*, **17**, 98 (1950).
4. KUNTZ, R. E., and WELLS, W. H. *Am. J. Trop. Med.* (In press).
5. SUTTON, L. J. *Earth and Water Temperatures in Egypt.* Cairo: Government Press (1946).
6. LITCHFIELD, J. T., JR., and WILCOXON, F. *J. Pharmacol. Exptl. Therap.*, **96**, 99 (1949).
7. VON BRAND, T., NOLAN, M. O., and MANN, E. R. *Biol. Bull.*, **95**, 199 (1948).
8. KROGH, A. *The Respiratory Exchange of Animals and Man.* London: Longmans, Green (1916).
9. STOLL, N. R. *J. Parasitol.*, **33**, 1 (1947).
10. BARLOW, C. H. *Am. J. Hyg.*, **25**, 327 (1937).
11. ABDEL AZIM, M., and AYYAD, N. *Trans. Roy. Soc. Trop. Med. Hyg.*, **42**, 231 (1948).

Manuscript received July 9, 1951.

[6] More than a million pounds per year are used in Egypt alone.

Chick-Growth Stimulation Produced by Surfactants[1]

C. M. Ely

Research Division,
National Distillers Products Corporation,
Cincinnati, Ohio

Certain surfactants have been found to produce an increased growth response in chicks. As part of a broad study on the use of distillers solubles in animal nutrition, it has been observed that these surfactants, when fed at levels ranging from 13 to 454 g/100 lbs mixed ration, will promote an increase in growth ranging to 12% above the controls. (Surprisingly, many commercial preparations for home laundry and dishwashing use are among the active types.) These results have been obtained in laboratory battery trials of more than two years' duration. A total of 125 individual test groups of 20 chicks each has been studied to date, all chicks being carried on experiment to 10 or 12 weeks of age. Practical-scale field trials have been conducted to check important laboratory findings.

[1] A preliminary report.

Tables 1 and 2 give the basal rations used and experimental data obtained in a typical test series on a rather thoroughly studied surfactant, an ethylene oxide condensate of coco fatty acids.

Evidence collected to date on B_{12}–antibiotic–surface-active-agent supplementation, both alone and in

TABLE 1

ALL-VEGETABLE BASAL DIETS USED FOR CHICK TESTS (Table 2)

Ingredient	Lbs/100 lbs	
	Basal for Series I and II	Basal for Series III
Ground yellow corn	60.0	60.5
Soybean oil meal (41%)	18.0	35.0
Corn gluten meal	10.0	—
Alfalfa meal	4.0	—
Distillers solubles	5.0	—
Feeding limestone	1.3	1.5
Steamed bone meal	1.0	2.0
1,500 A/400 D oil	.35	.50
Salt	.35	.50
$MnSO_4$	.02	.02
Riboflavin	—	(150 mg)
Total	100.02	100.02

TABLE 2

COMPARISON OF A SURFACE ACTIVE AGENT WITH B_{12} AND ANTIBIOTICS IN AN ALL-VEGETABLE–TYPE BROILER RATION

Series	Group	Supplement*	Amt Supplement fed for 100 lbs ration (grams)	Final† chick wt (lbs)	Lbs feed/lb gain
I	A	Control basal #1	None	2.82	2.71
	B	As "A" plus aureomycin supplement	50	3.22	2.57
	C	As "A" plus lauryl ethylene oxide condensate	50	3.09	2.84
II	A	Control basal #1	None	3.00	2.84
	B	As "A" plus terramycin supplement	50	3.14	2.67
	C	As "A" plus lauryl ethylene oxide condensate	50	3.31	2.85
III	A	Control basal #2	None	3.06	3.14
	B	As "A" plus vitamin B_{12}	50	3.33	3.26
	C	As "A" plus bacitracin supplement	50	3.34	3.08
	D	As "A" plus lauryl ethylene oxide condensate	50	3.34	2.97

* Antibiotic supplements used had a guaranteed potency of 5 g antibiotic/lb; B_{12} supplement used had a potency of 6 mg B_{12}/lb.

† Final chick weights in Series I and II were taken at 70th day; in Series III, on 84th day. Weights shown are the male-female average.

various combinations, points to a similarity between the chick-growth response on antibiotics and surface-active agents. Preliminary investigations of a possible synergistic effect between surfactants and B_{12}–antibiotic supplements have been negative. Further studies on this discovery are being continued by the Nutritional Group of National Distillers Research Division.

Manuscript received Sept. 11, 1951.

Hereditary Differences in Ability to Conceive Following Coitus in Mice[1]

T. D. Fainstat

Department of Genetics,
McGill University, Montreal, Canada

Recent studies of the effects on embryonic development of cortisone injected into pregnant mice included observations on the strain differences in response to treatment (*1*). The mice were of 5 genetically different stocks: strains A, C57 black, and Black and tan, all originally received from the Jackson Laboratory at Bar Harbor, a stock (N) carrying the mutant "Naked" which was inbred in this laboratory for 11 generations, and a genetically heterogeneous stock (H). Very early in the cortisone studies it was found that these 5 stocks of mice fell into two distinct groups with respect to incidence of cleft palate in the offspring of pregnant mice injected with cortisone. Stocks A and N showed a very high incidence, whereas stocks C57, Black and tan, and H produced a relatively low incidence of offspring with cleft palate.

Strain differences have also been found in the incidence of pregnancy following coitus. When a female was found with a vaginal plug it was assumed that she had been inseminated within the preceding 24-hr period.

Table 1 shows that pregnancy does not necessarily follow insemination of the adult female mouse and suggests that female mice of some stocks (A, N) are less likely to become pregnant following coitus than female mice of other stocks (C57, Black and tan, H).

TABLE 1

INCIDENCE OF PREGNANCY FOLLOWING OBSERVATION OF VAGINAL PLUG IN 5 STOCKS OF MICE

Stock	No. females with vaginal plug	No. pregnant	Percentage pregnant
A	35	5	14.3
N	14	4	28.6
C57	18	14	77.8
Black and tan	15	9	60.0
H	2	2	100.0

[1] This work is part of a project made possible by a grant from the National Research Council of Canada. Thanks are due F. Clarke Fraser for closely supervising the entire project.

TABLE 2

INCIDENCE OF PREGNANCY FOLLOWING OBSERVATION OF VAGINAL PLUG IN 2 GROUPS OF MICE*

Stock	No. females with vaginal plug	No. pregnant	Percentage pregnant
A, N	49	9	18.4
C57, Black and tan, H	35	25	71.4

* The difference between the two groups is highly significant at the 1% level ($\chi^2 = 9.8263$, $P < 0.01$).

In Table 2 the data presented in Table 1 are grouped according to susceptibility to cortisone treatment as measured by the incidence of cleft palate in the offspring of cortisone-treated pregnant females.

The animals of stocks A and N (both stocks highly susceptible to cortisone treatment) were significantly less likely to become pregnant following coitus than animals of C57, Black and tan, and H (the three stocks constituting the cortisone-resistant groups).

Reference

1. FRASER, F. C., and FAINSTAT, T. D. *Pediatrics* (in press).

Manuscript received July 2, 1951.

A Simple Technique for Repeated Collection of Blood Samples from Guinea Pigs

A. Vallejo-Freire

Virus Laboratory, Instituto Butantan,
São Paulo, Brazil

In studies on the action of antibiotics, chemotherapeutics, or antigenic substances, it is frequently necessary to bleed a guinea pig at certain intervals for micro- or semimicrochemical work related to their absorption, blood concentration, therapeutic activity, etc. Frequent bleedings may also be necessary in studies on blood circulation of bacteria, viruses, or antibodies. Heart puncture is not advised when re-

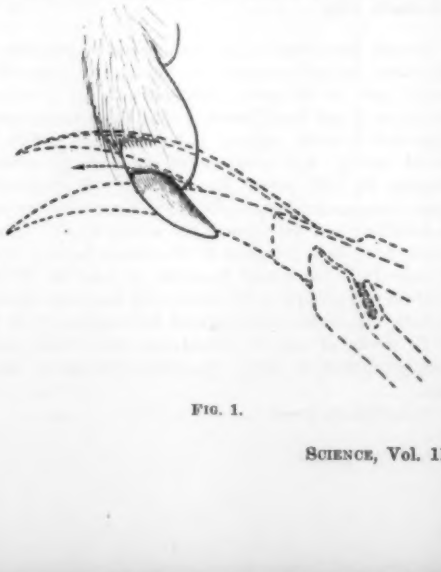


FIG. 1.

peated bleeding is necessary because of traumatic effects and the technical difficulty of obtaining repeated blood samples through this route. Bleeding from small vessels such as those of the ear lobe is difficult and not satisfactory when several blood samples are required within a short period of time.

The technique described here has been found simple and reliable in accomplishing this work. The procedure used in this laboratory allows us to draw easily small amounts of blood up to 14 times from the same guinea pig in one day. Although our experience has been limited, we believe the procedure may be used on rats as well. It has not been tried on other species.

Equipment

1 250-w, infrared ray lamp.

3% Sodium citrate solution.

Microscope slides with one or two concavities. The slide and capillary pipettes may be dry or may have been moistened with the sodium citrate solution with further drying.

Capillary tip pipettes.

Curved-on-flat dissecting scissors, 115 mm long.

Small metal spatula.

The animal's foot is cleaned to remove all interfering dirt, rinsed with the sodium citrate solution, and thoroughly dried with cotton or gauze. The nail is cut just at its insertion, giving the scissors an inclined position (Fig. 1). The foot is placed about 15 cm from the infrared ray lamp for 10 sec, which is enough to provoke dilatation of the vessels and to facilitate hemorrhage. Well-fed animals can be bled even without this irradiation. In certain infections or other pathological states, however, this detail is important, since sometimes spontaneous hemorrhage cannot be obtained.

Two bleedings can be made from the same nail insertion if a little tissue is removed from the insertion on the first cut. Thus it is rather easy to obtain up to 28 bleedings from the same animal within a short time. The blood is allowed to run from the nail to the slide concavities. Blood can be collected with a capillary pipette from the slide or directly from the cut. Bleeding is stopped by cauterizing with the small metal spatula or similar device.

The Free Energy of Hydrolysis of *p*-Nitrophenyl Phosphate[1]

Bernard Axelrod[2]

Enzyme Research Division, Bureau of Agriculture and Industrial Chemistry, ARA, USDA, Albany, California, and Kerckhoff Laboratories of Biology, California Institute of Technology, Pasadena

"Phosphotransferase" activity, which is found associated with certain phosphatase preparations, involves the transfer of phosphate from certain donor phosphates to suitable acceptors. We have previously reported that with some acid phosphatases of plant and animal origin, *p*-nitrophenyl phosphate can serve as a donor (*1*). Meyerhof and Green (*2, 3*) have more recently disclosed that the alkaline phosphatase prepared from intestinal mucosa also possesses phosphotransferase activity and can utilize as donors phosphocreatine, glucose-1-phosphate, and phosphoenolpyruvate as well as *p*-nitrophenyl phosphate. We have not been able to demonstrate any evidence of transfer with these first three substrates when employing citrus or alfalfa phosphotransferase. Of these substrates, only phosphoenolpyruvate was significantly hydrolyzed, and that but slightly.

Meyerhof and Green suggest that a correlation exists between the effectiveness of a donor with the $-\Delta F^\circ$ of its phosphate bond, in the case of the three nonaryl esters. They found nitrophenyl phosphate to be an excellent donor, and if their suggestion is correct this compound should have a high free energy of hydrolysis. It is the object of this paper to report the determination of the $-\Delta F^\circ$ of hydrolysis of nitrophenyl phosphate.

The determination was made by measuring the equilibrium constant of the hydrolysis of nitrophenyl phosphate. With even a moderately low value of $-\Delta F^\circ$, the equilibrium concentration of nitrophenyl phosphate would be so low as to evade measurement by ordinary phosphate determinations. However, with P^{32}-labeled phosphate it becomes relatively easy to measure the nitrophenyl phosphate formed, after isolating it by carrier nitrophenyl phosphate.

Reaction mixture A: This consisted of 65 ml of an aqueous solution, 0.332 *M* with respect to *p*-nitrophenol, 0.123 *M* with respect to P^{32}-labeled K_2HPO_4, and containing 40 mg of a commercial alkaline phosphatase prepared by the method of Schmidt and Thannhauser (*4*). The pH was 8.95. *Reaction mixture B:* This was the same as A, except that the enzyme was omitted. Reaction time, 72 hr; temperature, 38° C.

The synthesized ester was isolated along with added carrier (0.500 g disodium *p*-nitrophenyl phosphate · 2 H_2O) after first removing inorganic phosphate as $Ba_3(PO_4)_2$. The ester was obtained by barium precipitation with 5 volumes of ethanol. Three crystallizations were sufficient to give constant activity.

The equilibrium constant was calculated for the hydrolysis written in the following way:

and it is expressed in terms of total forms of each substance (without regard to ionic form) and its dissociation constant.

$$K = \frac{(P_t)\ (A_t)}{(E_t)\ (H_2O)} \times \frac{(H^+)}{(H^+) + K_4} \frac{\dfrac{(H^+)^2}{k'_E\, k''_E} + \dfrac{(H^+)}{k''_E} + 1}{\dfrac{(H^+)^2}{k'_P\, k''_P} + \dfrac{(H^+)}{k''_P} + 1},$$

where P_t refers to the total concentration of phosphate, and k'_P and k''_P to the first and second ioniza-

[1] Enzyme Research Division Contribution No. 137.

[2] The author is greatly indebted to H. Borsook, of the California Institute of Technology, for a very helpful discussion concerning the thermodynamic aspects of this paper.

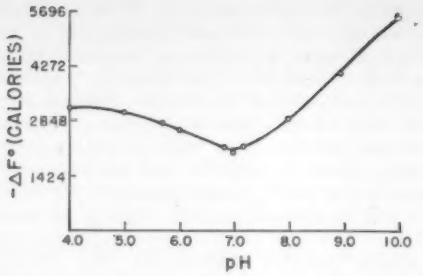


FIG. 1. Apparent "phosphate bond energy" of *p*-nitrophenyl phosphate.

tion constants of phosphoric acid, respectively. Similarly, E_t, k'_E and k''_E have corresponding meanings with respect to nitrophenyl phosphate and A_t and k_A with respect to nitrophenol.

As an approximation, concentrations are employed instead of activities. The concentration of water is assumed to be that of pure water. Following the convention of Lewis and Randall (*5*), the standard state of water is taken as pure water. pK values are not corrected to reaction temperature from their values as given in the literature. The following values were employed:

$$pK'_P = 1.97\ (6),\ pK''_P = 6.82\ (6),\ pK'_E = 2^8,$$
$$pK''_E = 5.7\ (7),\ pK'_A = 7.18\ (8).$$

The standard free energy of the above reaction is given by

$$\text{I}\quad \Delta F^\circ = -RT\ln\frac{(P_t)\ (A_t)}{(E_t)} - RT\ln$$
$$\left(\frac{(H^+)}{(H^+)+K_A}\right)\left(\frac{\frac{(H^+)^2}{k'_E\,k''_E}+\frac{(H^+)}{k''_E}+1}{\frac{(H^+)^2}{k'_P\,k''_P}+\frac{(H^+)}{k''_P}+1}\right)$$

It is not necessary to know the actual concentrations of P_t and E_t but only their ratio which, as a sufficiently good approximation, is equal to total radioactivity of the reaction mixture divided by the radioactivity found in the nitrophenyl phosphate. The value found in the reaction mixture was 2.135×10^6 cpm. In Expts A and B the nitrophenyl phosphate contained 732 and 1,064 cpm, respectively. The average ΔF° is $-1{,}615$ cals. This value refers to the reaction as written and is independent of pH.

It is common practice to evaluate the so-called free energy of hydrolysis of phosphate esters by the use of the "apparent equilibrium constant" (e.g., see Alberty *et al.* [*9*]), in which only the total concentrations of the reactants are considered. Such an expression corresponds to the first term in the right side of equation I. The "apparent ΔF°" is proportional to the r′P of Dixon (*10*). Fig. 1 shows the dependence of the "apparent ΔF°" on pH. The latter value is only moderately high at pH 4, namely, $-3{,}180$ cal; it drops slowly to a minimum of about $-2{,}200$ cal at pH 7.0, and then increases to higher values at the rate of $-1{,}424$ cal/pH unit.

The efficacy of a donor depends upon enzyme specificity with regard to the donor phosphate, the acceptor and its phosphate, as well as on energy considerations. Thus "bond" energies are only permissive in the matter of transferability. In the present case the "apparent ΔF°" values do happen to accord with our observation that efficacy of transfer in the acid region increased with decreasing pH (*1*).

[8] The primary dissociation constant of *p*-nitrophenyl phosphate is too low to permit its determination with a glass electrode. It is reasonable to assume that it is lower than k'_P, and by analogy with other phosphate esters the value cited above is probably of the right magnitude. However the difference in ΔF° occasioned by this uncertainty is inconsequential in the pH range for which calculations are shown.

References

1. AXELROD, B. *J. Biol. Chem.*, **172**, 1 (1948).
2. MEYERHOF, O., and GREEN, H. *Ibid.*, **183**, 377 (1950).
3. GREEN, H., and MEYERHOF, O. *Federation Proc.*, **9**, 179 (1950).
4. SCHMIDT, G., and THANNHAUSER, S. J. *J. Biol. Chem.*, **149**, 369 (1943).
5. LEWIS, G. N., and RANDALL, M. *Thermodynamics.* New York: McGraw-Hill (1923).
6. KUMLER, W. D., and EILER, J. J. *J. Am. Chem. Soc.*, **65**, 2355 (1943).
7. KING, E. J., and DELORY, G. E. *Biochem. J.*, **33**, 1185 (1939).
8. CLARK, W. M. *The Determination of Hydrogen Ions*, 3rd ed. Baltimore: Williams & Wilkins, 128 (1928).
9. ALBERTY, R. A., SMITH, R. M., and BOCK, R. M. To be published.
10. DIXON, M. *Multi-Enzyme Systems.* Cambridge: Cambridge Univ. Press (1948).

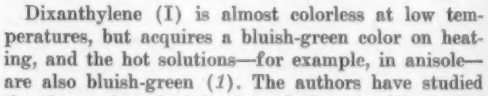
Reactions of Dibenzodixanthylenes

Ahmed Mustafa and Mustafa Kamal Hilmy

Chemistry Department, Faculty of Science, Fouad I University, Abbassia-Cairo, Egypt

Dixanthylene (I) is almost colorless at low temperatures, but acquires a bluish-green color on heating, and the hot solutions—for example, in anisole—are also bluish-green (*1*). The authors have studied the thermochromic behavior of the two dibenzodixanthylenes (II and III) and have found that (II) is pale-yellow at room temperature, green when molten, mp, 345° C, gives a bluish-green solution in warm anisole, and in general exhibits remarkable thermochromic behavior. (III), which forms yellowish-green crystals, melts at 295° C, forming an olive-green melt. Its solutions in anisole are more weakly thermochromic to the naked eye than solutions of (II). In both cases, (II) and (III), the reversibility of the thermochromic phenomenon is the same as in the case of dixanthylene (*2*).

(II) and (III) have been obtained by the action of copper bronze on 1: 2-benzoxanthone or 3: 4-benzo-



I II III IV

xanthone ketochloride, respectively (*3*). (II) has also been prepared by the action of copper bronze on 1:2-benzoxanthione (IV), which may be prepared by the action of thioacetic acid on 1:2-benzoxanthone ketochloride; similar reactions are known in the case of xanthione (*4*).

When dixanthylene (I) is heated with sulfur, xanthione is formed (*3*). Similar reactions were carried out with (II) and (III), and thus 1:2-benzoxanthione (IV), mp, 141°, and 3:4-benzoxanthione, mp, 148°, were obtained, respectively. When (II) and (III) are treated with oxalyl chloride, followed by the action of water, 1:2-benzoxanthone and 3:4-benzoxanthone are obtained, respectively (*5*).

A full report describing the previous reactions, the action of lithium aluminum hydride, the Grignard solutions on 1:2-benzoxanthone and 3:4-benzoxanthone, respectively, and the action of ethereal diazomethane on 1:2-benzoxanthione and 3:4-benzoxanthione, together with photochemical behavior of 9-aryl-1:2-benzoxanthen and 9-aryl-3:4-benzoxanthen toward oxygen (*6*) and the photo-action of *p*-benzoquinone (*7*) and oxygen (*6*), respectively, on 1:2-benzoxanthen will be published soon.

References

1. Schoenberg and Schuetz. *Ber.*, **61**, 478 (1928).
2. Schoenberg, Ismail, and Asker. *J. Chem. Soc.*, 442 (1946).
3. Schoenberg and Asker. *Ibid.*, 272 (1942).
4. Schoenberg, Schuetz, and Nickel. *Ber.*, **61**, 1375 (1928).
5. Schoenberg and Asker. *J. Chem. Soc.*, 725 (1942).
6. Schoenberg and Mustafa. *Ibid.*, 657 (1945); 997 (1947).
7. *Ibid.*, **67** (1944).

Method for Obtaining Large Yields of Human Platelets as a By-Product of Blood Collection[1]

Gustave Freeman

Division of Laboratories and Research,
The Children's Medical Center, and
The Children's Cancer Research Foundation,
Boston, Massachusetts

Clinical and experimental use of platelets has been limited by the expense and impracticality of obtaining them in quantity. The development of methods for storing blood (*1–4*) and isolating its constituents (*5, 6*) has permitted mass collection of human blood and detailed study of its fractions, including the formed elements (*7*). Among the latter, probably platelets are the least well understood, but the most important in thrombocytopenic conditions accompanied by bleeding. Recently the use of ion-exchange resin for the purpose of rendering blood incoagulable by fixing calcium ions (*8, 9*) proved, fortuitously, to cause partial disappearance of platelets from the blood. This apparent obstacle to the eventual harvesting of platelets by centrifugation for laboratory study and clinical use was turned to advantage when elution of the resin proved to be an efficacious means of salvaging quantities of platelets (*10*).

Blood-collecting and -transfusion sets (*9*) made of translucent plastic material (polyvinyl chloride acetate copolymer) and containing a column of ion-exchange resin (sulfonated polysterene divinyl benzene copolymer[2]) for making the blood incoagulable by decalcification were used. Needles were coated with tris (2-hydroxyethyl) dodecylamine.[3] The column of resin, contained in 28-mm plastic tubing, was suspended from the donor needle on the afferent end by small-caliber tubing and was led to the blood receptacle by similar tubing on the efferent end. The ion-exchanger consisted of 50 g of Dowex-50 beads on the sodium cycle. The resin was washed with saline solution and kept moist. Platelet suspensions were received in clean silicone-lined[4] flasks or bottles. The eluting fluid was unbuffered solution of 0.085% NaCl in distilled water. Ordinary 50-ml glass syringes equipped with metal adapter tips were used to deliver the physiologic saline eluting solution.

The usual blood donation unit of 500 ml was collected by means of the described blood-collecting set (*9*). The resin container was then cut free at both ends, leaving a few centimeters of tubing attached at each end. The contents of the resin container were then washed with the physiologic saline solution, simply by introducing the adapter tip of a syringe filled with saline solution into the open end of the snugly fitting afferent tube, forcing the saline through the resin container, and catching the washings in a silicone-lined bottle. Approximately 10 ml of saline solution was added at a time, and the resin and saline were manipulated by kneading the contents of the container from the outside with the fingers, to aid in freeing whatever blood elements were attached to the resin beads. This process, and straight flushing with portions of saline solution, were alternated as necessary.

In order to obtain platelets in concentrations equivalent to that of whole blood, for purposes of counting, each resin column was washed with 500 ml of saline solution, the original blood volume. Elutions were made, also, with smaller quantities, for purposes of concentrating the platelets. Platelet counts were made by the direct method, using 3.8% sodium citrate solution as a diluent (*11*). Sealing the tubing at both ends of the resin container, dielectrically (*9*), would simplify recovery of platelets under sterile conditions if that were desirable.

Washing of the resin with sufficient saline solution to make up the original blood volume resulted in high yields of platelets that had been filtered out by the resin. A series of resin columns, through each of which 500 ml of whole blood had been passed once, were eluted with 500 ml of saline solution. The average concentration of recovered platelets was approximately 119,000/mm^3, or about 40% of the total normal

[1] Work done in the laboratories of the Harvard Medical School in cooperation with the Blood Characterization and Preservation Laboratories of the Bussey Institution of Harvard University, University Laboratory of Physical Chemistry, and the American National Red Cross.

[2] Dowex-50, Dow Chemical.
[3] A-15, Armour and Company.
[4] Dri-Film 9987, General Electric.

TABLE 1

PLATELETS RECOVERED FROM ION-EXCHANGE COLUMNS AFTER PASSAGE OF 500-ML UNITS OF WHOLE BLOOD

Specimen	Platelets/mm³ whole blood	
	Loss*	Recovery†
1	138,000	130,500
2	102,000	78,000
3	128,000	106,000
4	178,000	162,000
Av	136,500	119,125
Percentage of filtered platelets recovered	88	

* Calculated as difference between counts on whole blood before and after passage through the resin column.
† Direct count on suspension in 500 ml of saline solution.

platelet complement (Table 1). Platelet counts made on the blood from the tubing below the needle immediately after cessation of flow from the donor and again after passage of the blood through the resin indicated losses of a similar magnitude; therefore, approximately 88% of the platelets filtered from the blood were recovered (Table 1). By passing the same unit of blood through a series of four identical resin columns, it was possible to recover an average of 89% of the platelets filtered from the blood (Table 2). Between 90 and 95% of the total platelet complement from 500 ml of blood is generally filtered out with four columns, the residual portion tending to remain with the blood even after further resin treatment.

Elution was carried out also with smaller volumes of saline solution. Approximately 70% of a possible total yield could be recovered with a volume of saline solution equivalent to 25% of the original blood volume. By manipulating the contents of the resin container, as many as 600,000 platelets/mm³ were obtained in a volume of 50 ml of saline solution, although usually only about half that concentration was seen. Although normal donors were used almost exclusively, considerable variability in platelet loss and recovery could be expected in any individual test. The platelet counts made on blood within the plastic tubing were erratic because of clumping, but served adequately as a check on recovery counts. There have been periods during which lower yields than are reported here were obtained. The circumstances with respect to the resin and the preparation of columns are being investigated.

TABLE 2

PLATELETS RECOVERED FROM SERIES OF FOUR ION-EXCHANGE COLUMNS AFTER PASSAGE OF INDIVIDUAL 500-ML UNITS OF WHOLE BLOOD

Specimen	Platelets/mm³ whole blood	
	Loss*	Recovery†
1	246,000	234,000
2	188,000	174,000
3‡	756,000	651,000
Total	1,190,000	1,059,000
Percentage of filtered platelets recovered	89	

* Calculated as difference between counts on whole blood before and after passage through four columns of resin.
† Sum of direct counts on four suspensions in 500 ml of saline solution each.
‡ Donor with polycythemia vera.

Platelets eluted from resin by the method described appeared entirely normal by visualization in the phase microscope.[5] Also, the prolonged clotting time of oxalated, platelet-poor, normal plasma was returned to normal by addition of such platelets in saline suspension.

When desirable, elimination of most of the red cells caught with the platelets by the ion-exchange resin could be carried out by allowing the suspension to settle in the cold for several hours, or by light centrifugation at 1,000 rpm[6] for 5–8 min at 4° C. Further differential centrifugation could be carried out to obtain purified platelet material if platelet morphology or individuality did not need to be preserved. Purification and concentration were always performed at the sacrifice of absolute quantity.

The accumulation of large quantities of human platelets as a by-product of blood collection during which ion-exchange resin is used to prevent coagulation provides a practical and substantial source of human platelets for use in the laboratory or in the clinic. The elimination of high-speed centrifugation, washing, and resuspension, which have been in general use, favors the preservation of the natural state of these elements. Also, the ease with which elution takes place and the physiological simplicity of the eluting fluid tend to maintain morphological and physiological integrity. Methods for improving the concentration and preservation of such platelet suspensions are being studied.

References

1. KILDUFFE, R. A., and DEBAKEY, M. *The Blood Bank and the Technique and Therapeutics of Transfusions.* St. Louis: Mosby (1942).
2. MUDD, S., and THALHIMER, W. *Blood Substitutes and Blood Transfusion.* Springfield, Ill.: Thomas (1942).
3. WHITE, C. S., and WEINSTEIN, J. J. *Blood Derivatives and Substitutes.* Baltimore: Williams & Wilkins (1947).
4. DEGOWIN, E. L., HARDIN, R. C., and ALSEVER, J. B. *Blood Transfusion.* Philadelphia: Saunders (1949).
5. COHN, E. J., *et al. J. Clin. Invest.*, **23**, 417 (1944).
6. COHN, E. J., *et al. J. Am. Chem. Soc.*, **72**, 465 (1950).
7. AMERICAN NATIONAL RED CROSS. *The Preservation of the Formed Elements and of the Proteins of the Blood.* Conf. Harvard Medical School, Boston, Jan. 6–9, 1949. Washington, D. C.: Red Cross (1949).
8. BUCKLEY, E. S., JR., GIBSON, J. G., II, and WALTER, C. W. In Mimeo. Proc. Conf. on Separation of the Formed Elements—The Protein, Carbohydrate, Lipid, Steroid, Peptide and other Components of Plasma. Univ. Lab. Physical Chemistry, Harvard Medical School, July 11, 1950.
9. WALTER, C. W. In Owen H. Wangensteen (chairman), *Surgical Forum.* Philadelphia: Saunders, 483 (1951).
10. FREEMAN, G. Mimeo. Minutes, Conf. on Leukocytes, Blood Characterization and Preservation Laboratory, Univ. Laboratory Physical Chemistry, Harvard University, Mar. 22, 1941.
11. TODD, J. C., and SANFORD, A. H. *Clinical Diagnosis by Laboratory Methods.* Philadelphia: Saunders (1948).

[5] James L. Tullis was kind enough to make this observation.
[6] International Centrifuge, No. 1.

Association Affairs

Symposia at the Philadelphia Meeting

AMONG the sessions which will cross interdisciplinary boundaries, and which are likely to be of especial interest to many who plan to attend the AAAS Meeting at Philadelphia Dec. 26–31, the following merit listing at this early date, as the entire program acquires form and substance:

GENERAL SYMPOSIA

1. **Soviet Science.** Arranged by Conway Zirkle, University of Pennsylvania, and Howard A. Meyerhoff, Administrative Secretary, AAAS.

Session 1. Thursday morning, Dec. 27, Conway Zirkle presiding.

1. Russian Genetics. Th. Dobzhansky, Columbia University.
2. Russian Physiology and Pathology. W. Horsley Gantt, The Johns Hopkins University.
3. Russian Psychology and Psychiatry. Ivan D. London, Russian Research Center, Harvard University.
4. Scientific Methods, East and West. Russ Ackoff, Case Institute of Technology.

Session 2. Thursday afternoon, Dec. 27, Clyde Kluckhohn, Russian Research Center, Harvard University, presiding.

1. Russian Contributions to Soil Science. Jacob S. Joffe, New Jersey Agricultural Experiment Station.
2. Russian Physics and Chemistry. John Turkevich, Princeton University.
3. Russian Mathematics. John R. Kline, University of Pennsylvania.
4. Scientific Inquiry and Intellectual Freedom in Russia (1850–1950). Lazar Volin, Office of Foreign Agricultural Relations, Department of Agriculture.
5. An Appraisal of Science in the USSR. Conway Zirkle.

2. **Operation Knowledge.** Arranged by William F. Hewitt, Jr., Howard University School of Medicine, Washington, D. C.; cosponsored by AAAS Sections A, C, D, F, I, N, and Q and by the American Library Association, the Chemical Literature Division of the American Chemical Society, and the Special Libraries Association.

Session 1. Sunday morning, Dec. 30, Samuel R. Powers, Teachers College, Columbia University, presiding.

1. Problems of Primary Publication. Milton O. Lee, Federation of American Societies for Experimental Biology.
2. Some Science Literature Problems and Parameters. Harold Oatfield, Chas. Pfizer & Co., Inc., Brooklyn, N. Y.
3. Communications Problems Especially Affecting Academic Scientists. William F. Hewitt, Jr.
4. Difficulties Experienced by Scientists in Obtaining Passports and Visas from the U. S. Department of State. William H. Pearlman, Jefferson Medical College, Philadelphia.
5. A Proposed Organization of Communications Scientists. Samuel A. Miles, Hagstrom Company, Inc., New York.

Session 2. Sunday afternoon, Dec. 30, Detlev W. Bronk presiding.

6. The Interpretation of Science through Press, Schools, and Radio. Watson Davis, Science Service, Washington, D. C.
7. Public Relations with Science. Ivor Griffith, Philadelphia College of Pharmacy and Science.
8. The Function of the Press in the Scientific Education of Adult Readers. Waldemar Kaempffert, the *New York Times*.
9. The Documentation of Technical Literature. Julian F. Smith, Office of Naval Research, Washington, D. C.
10. Unified Symbolism for World Understanding in Science. Oliver L. Reiser, University of Pittsburgh.

Session 3. Sunday evening, Dec. 30, Kirtley F. Mather presiding.

11. The International Physics Abstracting Service. Elmer Hutchisson, Case Institute of Technology, Cleveland.
12. The Story of the Division of Chemical Literature of the American Chemical Society. James W. Perry, Bjorksten Research Laboratory, Madison, Wis.
13. The Library of Congress and International Scientific Communications. Luther H. Evans, Library of Congress.
14. Libraries—Communications Centers or Stockpiles? M. J. Voigt, Carnegie Institute of Technology, Pittsburgh.

Special attention is called to the three sessions of the **Conference on Scientific Manpower** on the mornings of Friday, Saturday, and Sunday, Dec. 28, 29, 30. The conference, cosponsored by the AAAS Cooperative Committee on the Teaching of Science and Mathematics, AAAS Sections I, K, and M, the Engineers' Club of Philadelphia, and the Engineers' Council for Professional Development, was arranged by a committee of which Ralph M. Hogan, Human Resources Division, Office of Naval Research, is chairman. Presiding officers are M. H. Trytten, Office of Scientific Personnel, National Research Council; George B. Thom, Newark College of Engineering; and Dael Wolfle, Commission on Human Resources and Advanced Training, National Research Council. Speakers include Ralph M. Hogan; David Rodnick, Economic Cooperation Administration; Harry C. Kelly, National Science Foundation; John F. Hilliard, Defense Manpower Administration, Department of Labor; Elbridge Sibley, Social Science Research Council; Guy Kleis, Westinghouse Electric Corporation; William G. Torpey, Naval Research Laboratory; Herbert E. Longenecker, University of Pittsburgh; Henry Chauncey, Educational Testing Service; Claude J. Lapp, Office of Scientific Personnel, National Research Council; John C. Flanagan, American Institute for Research, University of Pittsburgh.

SECTIONAL SYMPOSIA

SECTION B. 1. **Semiconductors.** Arranged by P. H. Miller, Jr., University of Pennsylvania.

Part I. Friday morning, Dec. 28. Frederick Seitz, University of Illinois, presiding. Speakers: Malcolm Hebb, General Electric Research Laboratory; Albert Rose, RCA

Research Laboratory; Karl Lark-Horovitz, Purdue University.

Part II. Friday afternoon, Dec. 28. Robert Mauer, University of Illinois, presiding. Speakers: William Shockley, Bell Telephone Laboratories; John Morton, Bell Telephone Laboratories; Humboldt Leverenz, RCA Research Laboratory.

Attention also is called to a **Conference on Applied Physics,** Thursday afternoon, Dec. 27, Lyman J. Briggs, emeritus director, National Bureau of Standards, presiding. Speakers: Hugh L. Dryden, National Advisory Committee for Aeronautics; Philip M. Morse, Massachusetts Institute of Technology; Thomas H. Johnson, U. S. Atomic Energy Commission.

SECTION C. 2. **Monomolecular Layers.** Arranged by Harry H. Sobotka, Mount Sinai Hospital, New York.

Wednesday afternoon, Dec. 26, Harry H. Sobotka presiding. Speakers: Harry H. Sobotka; H. J. Trurnit, Army Chemical Center; F. R. Eirich, Polytechnic Institute of Brooklyn; W. A. Zisman and E. G. Shafrin, Naval Research Laboratory, Washington, D. C.; Harry H. Sobotka and Solomon Rosenberg, Mount Sinai Hospital; D. E. Beischer, Naval School of Aviation Medicine, Pensacola.

3. **Stream Pollution and Industrial Wastes.** Arranged by George D. Beal, Mellon Institute of Industrial Research.

Part I. Thursday morning, Dec. 27, George D. Beal presiding. Speakers: George D. Beal; W. B. Hart, Atlantic Refining Company; J. B. Graham, U. S. Geological Survey; R. E. Teague, Sanitary Water Board, Commonwealth of Pennsylvania; Ruth Patrick, Academy of Natural Sciences of Philadelphia.

Part II. Thursday afternoon, Dec. 27, George D. Beal presiding. Speakers: R. F. Weston, Atlantic Refining Company; S. A. Braley, Mellon Institute of Industrial Research; S. R. Hoover, Northeast Regional Laboratory, Philadelphia; C. E. Renn, The Johns Hopkins University; L. D. Betz, consulting chemist, Philadelphia; George D. Beal.

4. **Recent Advances in Catalysis.** Arranged by E. H. Riddle, Rohm & Haas Company, Philadelphia.

Friday morning, Dec. 28, E. H. Riddle presiding. Speakers: E. H. Riddle; M. T. O'Shaugnessy, Polytechnic Institute of Brooklyn; L. P. Hammett, Columbia University; Heinz Heinemann, G. A. Mills, and A. G. Oblad, Houdry Process Corporation.

5. **The Chemistry of Colchicine and Related 7-membered Carbocyclic Compounds.** Arranged by Glenn E. Ullyot, Smith, Kline & French Laboratories.

Friday afternoon, Dec. 28, Glenn E. Ullyot presiding. Speakers: Glenn E. Ullyot; Henry Rapoport, University of California, Berkeley; Evan Horning, National Heart Institute; William E. Doering, Columbia University.

6. **Scientific Evidence Pertaining to the Time of Death.** Joint program of AAAS Section C and the American Academy of Forensic Sciences. Arranged by Ralph F. Turner, Michigan State College.

Part I. Saturday morning, Dec. 29, Samuel A. Levinson, University of Illinois College of Medicine, presiding. Speakers: S. A. Levinson; Samuel Gerber, Coroner, Cuyahoga County, Ohio; S. H. Durlacher, Medical Examiner's Office, Baltimore; W. W. Jetter, Boston University School of Medicine; Milton Helpern, Office of the Chief Medical Examiner, New York.

Part II. Saturday afternoon, Dec. 29, Samuel A. Levinson presiding.

7. **Recent Advances in Petroleum and Petroleum Technology.** Arranged by A. G. Oblad and Heinz Heinemann, Houdry Process Corporation.

Part I. Sunday morning, Dec. 30, A. G. Oblad presiding. Speakers: A. G. Oblad; Thomas S. Oakwood, Pennsylvania State College; L. P. Whorton and Lycurgus Laskaris, The Atlantic Refining Company; T. A. Burtis, J. C. Dart, and J. W. Schall, Houdry Process Corporation; M. A. Elliott, Bureau of Mines, Pittsburgh.

Part II. Sunday afternoon, Dec. 30, Heinz Heinemann presiding. Speakers: Eugene Ayres, Gulf Oil Corporation; Max Neuhaus and N. B. Sommer, Jefferson Chemical Company; J. B. Hill, Sun Oil Company.

SECTION D. 8. **Astronomical Photoelectric Photometry: Recent Developments in Techniques and Instrumentation.** Joint program of AAAS Section D, the Amateur Astronomers of the Franklin Institute, and the Rittenhouse Astronomical Society. Arranged by Frank K. Edmondson, Indiana University.

Monday morning, Dec. 31, Harold L. Alden, University of Virginia, and Frank Bradshaw Wood, University of Pennsylvania, presiding. Speakers: Albert P. Linnell, Amherst College Observatory; John S. Hall, U. S. Naval Observatory; William Blitzstein, Flower Observatory, University of Pennsylvania, and Cook Observatory, Franklin Institute; Bengt Strömgren, Yerkes Observatory, University of Chicago; Albert E. Whitford, Washburn Observatory, University of Wisconsin.

SECTION E. 9. **The Nation's Water: Want, Waste, and Why?** Program of AAAS Section E, cosponsored by the Geological Society of America. Arranged by Jack B. Graham, U. S. Geological Survey.

Thursday afternoon. Dec. 27, A. N. Sayre, U. S. Geological Survey, presiding. Speakers: J. R. Mahoney, Library of Congress; Harry E. Jordan, American Water Works Association; Gilbert F. White, Haverford College; Morris L. Cooke, consulting engineer in management, Philadelphia; Frances A. Pitkin, Pennsylvania State Planning Board and Interstate Commission on the Delaware River Basin; Harold E. Thomas, U. S. Geological Survey, Salt Lake City; Abel Wolman, The Johns Hopkins University; Milo F. Draemel, Department of Forests and Waters, Commonwealth of Pennsylvania; C. V. Youngquist, Ohio State Department of Natural Resources.

10. **Crystalline Rocks of the Appalachians.** Program of AAAS Section E, cosponsored by the Geological Society of America. Arranged by Leland Horberg, University of Chicago.

Part I. Friday morning, Dec. 28, Kenneth K. Landes, University of Michigan, presiding. Speakers: A. S. Furcron, State of Georgia Department of Mines; William R. Brown, University of Kentucky; Philip B. King, U. S. Geological Survey, Gatlinburg, Tenn.; Judith W. Frondell, Belmont, Mass.; Ernst Cloos, The Johns Hopkins University; Edward H. Watson, Bryn Mawr College.

Part II. Friday afternoon, Dec. 28, Ernst Cloos presiding. Speakers: Walter H. Bucher, Columbia University; Jarvis B. Hadley, U. S. Geological Survey, Gatlinburg, Tenn.;

Janet M. Aitken, University of Connecticut; Marshall Kay, Columbia University; John Rogers, Yale University.

11. **Foreign Petroleum Geology and Carbon 14.** Program of AAAS Section E, cosponsored by the Geological Society of America. Arranged by Leland Horberg, University of Chicago.

Friday morning, Dec. 28, Hollis Hedberg, Gulf Oil Corporation, and A. W. Weeks, Sun Oil Company, presiding. Speakers: George Gyre and Thomas G. Payne, U. S. Geological Survey; C. M. Pollock, Surbiton, Surrey, Eng.; Frank Reeves, U. S. Department of the Interior; C. W. Flagler, Gulf Oil Corporation; Vittorio Fois, Azienda Generale, Milan, Italy; J. Dupouy-Camet, Compagnie Française des Petroles, Paris; J. Lawrence Kulp, Lamont Geological Observatory, Palisades, N. Y.

12. **Foreign Petroleum Geology and Petroleum Economics.** Program of AAAS Section E, cosponsored by the Geological Society of America. Arranged by Leland Horberg, University of Chicago.

Friday afternoon, Dec. 28, G. Moses Knebel, Standard Oil Company, and John F. Mason, Atlantic Refining Company, presiding. Speakers: Sherman Abrahamson, Bureau of Mines; N. E. Baker and F. R. S. Henson, Iraq Petroleum Co., Ltd., New York and London; Earle F. Taylor, DeGolyer & MacNaughton, Dallas; Cecil Hagen, Gulf Building, Houston; Manuel Alvarez, Jr., Petróleos Mexicanos, Mexico, D. F.

SECTION F. 13. **Hormones in Invertebrate Animals.** Joint program of AAAS Section F and the American Society of Zoologists. Arranged by Douglas M. Whitaker, Stanford University.

Thursday afternoon, Dec. 27, Douglas M. Whitaker presiding. Speakers: Dietrich Bodenstein, Army Chemical Center; Carroll M. Williams, Harvard University; F. A. Brown, Northwestern University; J. H. Welsh, Harvard University.

14. **Sex in Microorganisms.** Joint program of AAAS Sections F and G, cosponsored by the American Society of Protozoologists, the American Society of Zoologists, the Botanical Society of America, and the Genetics Society of America. Arranged by David H. Wenrich, University of Pennsylvania.

Part I. Sunday morning, Dec. 30, Ivey F. Lewis, University of Virginia, presiding. Speakers: N. Visconti, Carnegie Institution of Washington, Cold Spring Harbor; W. G. Hutchinson and H. Stempen, University of Pennsylvania; John R. Raper, University of Chicago; Ralph A. Lewin, Yale University.

Part II. Sunday afternoon, Dec. 30, D. H. Wenrich, University of Pennsylvania, presiding. Speakers: L. R. Cleveland, Harvard University; David L. Nanney, University of Michigan; D. H. Wenrich.

15. **Estuarine Ecology.** Program of AAAS Section F, cosponsored by the American Society of Limnology and Oceanography, the American Society of Zoologists, and the Ecological Society of America. Arranged by R. V. Truitt, Department of Research and Education, Solomons, Md.

Part I. Sunday morning, Dec. 30, George L. Clarke, Harvard University, presiding. Speakers: Alfred C. Redfield, Woods Hole Oceanographic Institution; Donald W. Pritchard, Chesapeake Bay Institute; Henry M. Stommel, Woods Hole Oceanographic Institution; Dayton E. Carritt, Chesapeake Bay Institute; Bostwick H. Ketchum, Woods Hole Oceanographic Institution.

Part II. Sunday afternoon, Dec. 30, Thurlow C. Nelson, Rutgers University, presiding. Speakers: James B. Lackey, The Blakiston Company; Charles E. Renn, The Johns Hopkins University; A. W. H. Needler, Atlantic Biological Station, Canada; A. G. Huntsman, Fisheries Research Board of Canada.

SECTION G. 16. **The Use of Isotopes in Botany.** Program of AAAS Section G, cosponsored by the Botanical Society of America. Arranged by Alexander Hollaender, Oak Ridge National Laboratory.

Saturday morning, Dec. 29, Ivey F. Lewis, University of Virginia, presiding. Speakers: Alexander Hollaender; Sterling B. Hendricks, U. S. Department of Agriculture; G. R. Noggle, Oak Ridge National Laboratory; C. L. Comar, University of Tennessee; Philip H. Abelson, Carnegie Institution of Washington.

17. **The New Jersey Pine Barrens.** Joint program of AAAS Section G and the Ecological Society of America. Arranged by John A. Small, Rutgers University.

Saturday afternoon, Dec. 29, John A. Small presiding. Speakers: J. C. F. Tedrow, New Jersey Agricultural Experiment Station; J. E. Potzger, Butler University; John M. Fogg, Jr., University of Pennsylvania; Silas Little, Northeastern Forest Experiment Station, New Lisbon, N. J.; H. H. Chapman, Yale University; J. E. Cantlon, George Washington University and Murray F. Buell, Rutgers University; H. C. Barksdale, U. S. Geological Survey, Trenton; C. B. Cranmer, Department of Conservation and Economic Development, New Jersey State.

18. **Foods and People.** Panel discussions arranged by Gove Hambidge, Food and Agriculture Organization of the United Nations.

Sunday, Dec. 30, Gove Hambidge presiding. Panel members: H. G. Bennett, U. S. Department of State and Oklahoma A & M College; John D. Black, Harvard University; Charles E. Kellogg, U. S. Soil Survey; L. A. Maynard, Food and Nutrition Board, National Research Council, and Cornell University; Conrad Taeuber, Bureau of the Census; and others.

SECTION H. 19. **Sex Education and its Relation to the Sexual Behavior of Children and Young Adults.** Joint program of AAAS Section H and the Society for Research in Child Development. Arranged by Charlotte del Solar, Child Study Center, Yale University.

Thursday afternoon, Dec. 27, Thomas W. Richards, Northwestern University, presiding. Speakers: Edith Jacobson, New York; Glenn V. Ramsey, Madison, N. J.; John Whiting, Harvard University.

20. **Use of Statistical Models to Interpret Data on Human Population Genetics.** Joint program of AAAS Section H and the Biometric Society, Eastern North American Region. Arranged by J. N. Spuhler, U. S. Navy and University of Michigan.

Thursday afternoon, Dec. 27, Marian W. Smith, U. S. Department of State, presiding. Speakers: C. C. Li, University of Pittsburgh; J. V. Neel, University of Michigan; Bentley Glass, The Johns Hopkins University; J. N. Spuhler; D. J. Hager, Princeton University; Howard Levene, Columbia University; Clyde Kluckhohn, Harvard University.

21. **Prehistoric and Historic Asia: Transpacific Con-**

tacts with the New World. Program of AAAS Section H, cosponsored by the Society for American Archäeology and the University Museum of the University of Pennsylvania. Arranged by Marian W. Smith, Foreign Service Institute, U. S. Department of State.

Part I. **Culture History of the Arctic and the Northern Pacific.** Friday morning, Dec. 28, James Louis Giddings, University Museum, University of Pennsylvania, presiding. Speakers: H. B. Collins, Smithsonian Institution; F. G. Rainey, University Museum, University of Pennsylvania; A. C. Spaulding, University of Michigan; C. McClellan, Forest Springs, Pennsylvania; Frederica de Laguna, Bryn Mawr College; D. Jenness, National Museum, Ottawa, Canada; J. B. Griffin, University of Michigan.

Part II. **Prehistory and History of Asia and the Near East, I.** Friday afternoon, Dec. 28, Lauriston Ward, Harvard University, presiding. Speakers: J. L. Angel, Jefferson Medical College, Philadelphia; R. M. Adams, Oriental Institute, Chicago; H. L. Movius, Jr., Harvard University; B. S. Kraus, University of Arizona.

Part III. **Prehistory and History of Asia and the Near East, II.** Saturday morning, Dec. 29, Lauriston Ward presiding. Speakers: Robert Dyson, Jr., Harvard University; Louis Du Pree, Harvard University; Elizabeth E. Bacon, Washington University; R. K. Beardsley, University of Michigan.

Part IV. **Modern Developments in the Culture History of Asia.** Saturday afternoon, Dec. 29, Schuyler V. R. Cammann, University Museum, University of Pennsylvania, presiding. Speakers: T. K. Noss, Adelphi College; Simon Marcson, Populations Division, United Nations; W. N. Brown, University of Pennsylvania; Holden Furber, University of Pennsylvania; Gardner Murphy, College of the City of New York, and Pars Ram, East Punjab University, Delhi.

Part V. **Culture History and the Question of Transpacific Contacts between Asia and the New World.** Sunday morning, Dec. 30, F. G. Rainey, University Museum, presiding. Speakers: G. F. Carter, The Johns Hopkins University; Gordon F. Ekholm, American Museum of Natural History; Ralph Linton, Yale University.

22. **Social Structure.** Joint program of AAAS Section H and the American Sociological Society. Arranged by Marian W. Smith.

Friday afternoon, Dec. 28, Talcott Parsons, Harvard University, presiding. Speakers: G. C. Homans, Harvard University; G. P. Murdock, Yale University; E. Shils, University of Chicago; Marian W. Smith.

23. **Cultural Relativism.** Joint program of AAAS Section H and the Eastern Division of the American Philosophical Association. Arranged by Richard B. Brandt, Swarthmore College.

Saturday afternoon, Dec. 29, A. E. Murphy, Cornell University, presiding. Speakers: Clyde Kluckhohn, Harvard University; Ralph Linton, Yale University; Philip Blair Rice, Kenyon College.

SECTION L. 24. **Rewards of Research.** Arranged by Raymond J. Seeger, Naval Ordnance Laboratory.

Friday afternoon, Dec. 28, Conway Zirkle, University of Pennsylvania, presiding. Speakers: Alan T. Waterman, National Science Foundation; R. Bruce Lindsay, Brown University; Raymond J. Seeger.

25. **Philosophical Postulates of Physics.** Joint program of AAAS Section L and the Eastern Division of the American Philosophical Association. Arranged by Richard B. Brandt, Swarthmore College.

Saturday afternoon, Dec. 29, Raymond J. Seeger presiding. Speakers: A. W. Burks, University of Michigan; Henry Margenau, Yale University; Herbert Feigl, University of Minnesota.

26. **History of Science.** Arranged by I. Bernard Cohen, Harvard University.

Sunday afternoon, Dec. 30, Conway Zirkle presiding. Speakers: Thomas S. Kuhn, Harvard University; Brooke Hindle, New York University; Wyndham D. Miles, Pennsylvania State College.

SECTION M. 27. **Prosthetic and Sensory Aids—Engineering, Design, and Uses.** Joint Program of AAAS Section M and the American Society of Mechanical Engineers. Arranged by E. F. Murphy, Prosthetic and Sensory Aids Service, Veterans Administration, New York.

Part I. Thursday morning, Dec. 27, Paul E. Klopsteg, Northwestern Technological Institute, presiding. Speakers: R. Tweedale, Vickers, Inc., Detroit; S. Fishman, New York University; A. Nathan, New York University, and B. Walder, Veterans Administration; C. C. Haddan, American Board for Certification of the Prosthetic and Orthopedic Appliance Industry, Inc.; W. Tosberg, Veterans Administration.

Part II. Thursday afternoon, Dec. 27, Philip D. Wilson, Hospital for Special Surgery, New York, presiding. Speakers: M. Fletcher, U. S. Army, Forest Glen, Md.; F. Leonard, Army Prosthetics Research Laboratory, Forest Glen, Md.; A. W. Spittler, Walter Reed Hospital; E. F. Murphy, Veterans Administration.

28. **Nuclear Engineering.** Arranged by Irving P. Orens, Newark College of Engineering.

Part I. Friday morning, Dec. 28, Irving P. Orens, presiding. Speakers: Conrad P. Straub and Donald Pecsock, U. S. Public Health Service; R. H. Simons, Knolls Atomic Power Laboratory, Schenectady.

Part II. Friday afternoon, Dec. 28, Irving P. Orens, presiding. Speakers: J. C. Suddath, Oak Ridge National Laboratory; Robert H. Wilson, University of Rochester; Paul C. Aebersold, Isotopes Division, U. S. Atomic Energy Commission; David Gurinsky, Brookhaven National Laboratory.

29. **The Joint Participation of Engineers and Medical Scientists in the Activities of the Navy Aeronautical Medical Equipment Laboratory.** Joint program of AAAS Section M and the schools or departments of engineering of the University of Pennsylvania, Drexel Institute of Technology, Swarthmore College, and Villanova College. Arranged by L. G. Gulick, Towne Scientific School, University of Pennsylvania; R. C. Disque, Drexel Institute of Technology; J. Stanley Morehouse, Villanova College; and W. E. Reaser, Swarthmore College.

Saturday morning, Dec. 29, E. M. Wurzel, Naval Aeronautical Medical Laboratory, Philadephia, presiding. Speakers: C. T. Koochembere, E. Hendler, E. L. Hays, F. R. Brown and E. M. Wurzel, Naval Aeronautical Medical Laboratory.

30. **The Engineer and Scientific Research.** Program of AAAS Section M and the schools or departments of engineering of the Philadelphia region (as above).

Part I. Saturday afternoon, Dec. 29, R. C. Disque presiding. Speakers: Charles P. Bailey, Hahemann Medical College and Hospital, Philadelphia; C. E. Fink, Drexel Institute of Technology.

Part II. Saturday evening, Dec. 29, J. Stanley Morehouse presiding. Speakers: Albert J. Williams, Jr., Leeds & Northrup Company; John Grist Brainerd, University of Pennsylvania; John A. Goff, University of Pennsylvania.

SUBSECTION NM. 31. **Experimental and Clinical Aspects of Lipid Metabolism, Arteriosclerosis, and the Aging Process.** Program of AAAS Subsection Nm, cosponsored by the American Geriatrics Society, the Society for the Study of Arteriosclerosis, and the Gerontological Society, Inc. Arranged by Gordon K. Moe, New York State University Medical Center, Syracuse.

Part I. Saturday morning, Dec. 29, Irvine H. Page, The Cleveland Clinic, presiding. Speakers: David P. Barr, Cornell University Medical College; Eli Moschcowitz, Mount Sinai Hospital, New York; L. L. Waters, Yale University School of Medicine; Russell L. Holman, Louisiana State University School of Medicine.

Part II. Saturday afternoon, Dec. 29, Charles F. Wilkinson, Jr., New York University Postgraduate School, presiding. Speakers: Nathan W. Shock, National Institutes of Health and Baltimore City Hospitals; Lena Lewis, Arda H. Green, and Irvine H. Page, The Cleveland Clinic; M. M. Gertler, Francis Delafield Hospital, New York; John W. Gofman *et al.*, Donner Laboratory, University of California, Berkeley; Jeremiah Stamler, Michael Reese Hospital, Chicago.

Part III. Sunday morning, Dec. 30, Harry E. Ungerleider, The Equitable Life Assurance Society, New York, presiding. Speakers: Alfred Steiner, New York; Ancel Keys, University of Minnesota; Campbell Moses, Jr., University of Pittsburgh; J. C. Paterson, University of Western Ontario, London; Benjamin M. Baker, William Scarborough, Martin Singewald, and Robert E. Mason, Baltimore.

Part IV. Sunday afternoon, Dec. 30, Nathan W. Shock presiding. Speakers: Edwin O. Wheeler, Massachusetts General Hospital, and Howard B. Sprague, Brookline, Mass.; Charles F. Wilkinson, Jr.; J. Murray Steele, Goldwater Memorial Hospital, Welfare Island, New York; Henry L. Taylor, University of Minnesota; Paul Starr, University of Southern California.

SUBSECTION ND. 32. **Fluoridation as a Public Health Measure.** Arranged by James H. Shaw, Harvard School of Dental Medicine, and Harold C. Hodge, University of Rochester School of Medicine and Dentistry.

Friday afternoon, Dec. 28, James H. Shaw presiding. Speakers; Zachary M. Stadt, Health Department, Charlotte, N. C.; Edward J. Largent, College of Medicine, University of Cincinnati; Gerald J. Cox, School of Dentistry, University of Pittsburgh; Harold C. Hodge and F. A. Smith, University of Rochester School of Medicine and Dentistry; R. S. Harris, Massachusetts Institute of Technology.

SUBSECTION NP. 33. **A Panel Discussion of the Newer Toxicants of Medical, Economic, and Pharmaceutical Interest.** Program of AAAS Subsection Np, cosponsored by the American Pharmaceutical Association, Scientific Section, and the American Society of Hospital Pharmacists. Arranged by George F. Archambault, Pharmacy Branch, U. S. Public Health Service.

Saturday afternoon, Dec. 29, Bernard E. Conley, American Medical Association, moderator. Speakers: Arnold J. Lehman, Pharmacology Division, U. S. Food and Drug Administration; E. E. Fleck, Bureau of Entomology and Plant Quarantine, Beltsville, Md.; Francis F. Heyroth, Kettering Institute for Applied Physiology, Cincinnati; R. Blackwell Smith, Pharmacy School, Medical College of Virginia; Kenneth P. DuBois, Toxicity Laboratory, University of Chicago.

SECTION O. 34. **Mineral Nutrition of Plants, Animals, and Man.** Arranged by C. E. Millar, Michigan State College.

Part I. Thursday morning, Dec. 27, Victor A. Tiedjens, Virginia Truck Experiment Station, presiding. Speakers: Victor A. Tiedjens; George D. Scarseth, Indiana Agricultural Experiment Station; Jacob S. Joffe, New Jersey Agricultural Experiment Station; Kenneth C. Beeson, U. S. Plant Soil and Nutrition Laboratory, Ithaca, N. Y.; L. L. Danielson, Virginia Truck Experiment Station.

Part II. Thursday afternoon, Dec. 27, Victor A. Tiedjens, presiding. Speakers: Malcolm Hedley McVickar, National Fertilizer Association, Washington, D. C.; Elvin C. Stakman, University of Minnesota; Leonard Haseman and Philip Carton Stone, University of Missouri; James Edward McMurtrey, Jr., U. S. Plant Industry Station, Beltsville, Md.

Part III. Friday morning, Dec. 28, Victor A. Tiedjens, presiding. Speakers: W. B. Mack, Pennsylvania State College; J. R. Taylor, American Plant Food Council, Inc., Washington, D. C.; J. D. Romaine, American Potash Institute, Inc., Washington, D. C.; Russell Coleman, National Fertilizer Association, Washington, D. C.

Part IV. Friday afternoon, Dec. 28, Victor A. Tiedjens, presiding. Speakers: Pauline Mack, Pennsylvanin State College; W. D. McElroy, The Johns Hopkins University; Wilma Brewer, Michigan State College; A. L. Moxon, Ohio Agricultural Experiment Station; Folke Skoog, University of Wisconsin.

35. **Improvement of Soil Structure.** Program of AAAS Section O, cosponsored by AAAS Section C and G. Arranged by N. N. T. Samarna, Central Research Department, Monsanto Chemical Company, Dayton, Ohio.

Part I. Saturday morning, Dec. 29, Firman E. Bear, Rutgers University, presiding. Speakers: G. W. Volk, Ohio Agricultural Experiment Station; J. H. Quastel, McGill University; R. M. Hedrick and D. T. Mowry, Monsanto Chemical Company; R. A. Ruehrwein and D. W. Ward, Monsanto Chemical Company; L. E. Allison, U. S. Salinity Laboratory, Riverside, Calif.

Part II. Saturday afternoon, Dec. 29, C. E. Millar, Michigan State College, presiding. Speakers: W. P. Martin, G. S. Taylor, and G. W. Volk, Ohio Agricultural Experiment Station; L. E. Weeks and W. G. Colter, Monsanto Chemical Company; L. S. Goodman, Ohio State University; L. V. Sherwood, Monsanto Chemical Company.

SECTION Q. 36. **The Work of the Science Teacher.** Arranged by S. R. Powers, Teachers College, Columbia University.

Part I. Saturday morning, Dec. 29, S. R. Powers, presiding. Speakers: Fletcher Watson, Harvard University; J. S. Richardson, Ohio State University; V. Crowell, State Teachers College, Trenton, N. J.; Ralph W. Lefler, Purdue University; R. W. Burnett, University of Illinois;

V. C. Lingren, University of Pittsburgh; H. E. Wise, University of Nebraska; William C. Forbes, State Teachers College, Troy, Ala.; M. Oakes, Queens College, Flushing, N. Y.; J. G. Manzer, State Teachers College, Trenton, N. J.; Ellis Haworth, Wilson Teachers College, Washington, D. C.

Part II. Saturday afternoon, Dec. 29, S. R. Powers presiding. Speakers: W. Jacobson, Teachers College, Columbia University; J. D. Barnard, New York University; R. H. Lampkin, State Teachers College, Buffalo, N. Y.; R. E. McKay, Bowling Green State University, Ohio; G. Mallinson, Western Michigan College of Education; G. M. Dunning, U. S. Atomic Energy Commission; J. Zipper, Gannon College; T. J. Blisard, Newark College of Engineering; N. E. Bingham, University of Florida; D. G. Decker, Colorado State College of Education; P. Warren, Madison College.

Other Symposia

Among the sessions arranged by the 71 participating societies and other organizations, symposia considered to be of particular interest are listed here.

1. **Cancer Therapy with Radioisotopes.** Joint program of the Oak Ridge Institute of Nuclear Studies and the Isotopes Division of the U. S. Atomic Energy Commission. Arranged by Marshall Brucer, Medical Division, Oak Ridge Institute of Nuclear Studies.

Part I. **Internally Administered Radiation.** Friday morning, Dec. 28, Marshall Brucer presiding. Speakers: Lowell Erf, Medical College Hospital, Philadelphia; William Beierwaltes, University of Michigan; Gould A. Andrews, Medical Division, Oak Ridge Institute of Nuclear Studies; H. D. Bruner, Medical Division, Oak Ridge Institute of Nuclear Studies; J. A. Cox, Reactor Department, Oak Ridge National Laboratory; S. Allan Lough, Isotopes Division, U. S. Atomic Energy Commission; Richard H. Chamberlain, University of Pennsylvania.

Part II. **New Developments in Teletherapy.** Friday afternoon, Dec. 28, Marshall Brucer presiding. Speakers: Robert Robbins, Temple University Hospital; C. B. Braestrup, City Department of Hospitals, New York; J. R. Mason, Radioisotopes Branch, U. S. Atomic Energy Commission; A. F. Rupp, Radioisotopes Development Department, Oak Ridge National Laboratory; Marshall Brucer; Max Cutler, Chicago Tumor Institute.

Part III. **The Impact of Radioisotopes in Cancer Research.** Friday evening, Dec. 28, Marshall Brucer presiding. Speakers: Paul Aebersold, Isotopes Division, U. S. Atomic Energy Commission; Albert H. Holland, Jr., Armour Laboratories; Shields Warren, Division of Biology and Medicine, U. S. Atomic Energy Commission.

2. **Classification of Animals.** Program of the Society of Systematic Zoology. Arranged by G. W. Wharton, Duke University.

Thursday evening, Dec. 27, G. W. Wharton presiding. Speakers: A. S. Romer, Harvard University; Alan Boyden, Rutgers University; Carl L. Hubbs, Scripps Institution of Oceanography; Th. Dobzhansky, Columbia University.

3. **Modern Methods for Microscopy, II.** Program of American Microscopical Society. Arranged by Oscar W. Richards, American Optical Company, Stamford, Conn.

Friday afternoon, Dec. 28, Oscar W. Richards presiding. Speakers: Oscar W. Richards; A. K. Parpart, Princeton University; S. Inoue, University of Washington; A. J. Kavanagh, Research Laboratory, American Optical Company; R. C. Mellors, Sloan-Kettering Institute for Cancer Research.

4. **Premedical Education and Social Health.** Program of Alpha Epsilon Delta, cosponsored by AAAS Sections K and Nm, the American Society of Zoologists, and Beta Beta Beta Honorary Biological Fraternity. Arranged by Maurice L. Moore, Vick Chemical Company.

Friday afternoon, Dec. 28, Eric H. Faigle, Syracuse University, presiding. Speakers: Hugh E. Setterfield, School of Medicine, Ohio State University; J. McK. Mitchell, University of Pennsylvania; Maurice H. Greenhill, Duke University; L. E. Woodward, New York Department of Mental Hygiene.

5. **The Role of Industrial Hygiene in Industrial Science.** Program of the American Industrial Hygiene Association, cosponsored by AAAS Section P. Arranged by Anna M. Baetjer, The Johns Hopkins School of Hygiene and Public Health.

Friday afternoon, Dec. 28, Anna M. Baetjer and Frank A. Patty, General Motors Research Laboratory, presiding. Speakers: Theodore F. Hatch, Graduate School of Public Health, University of Pittsburgh; Henry F. Smyth, Jr., Mellon Institute; James H. Sterner, Medical Department, Eastman Kodak Company; Allen D. Brandt, Medical Division, Bethlehem Steel Company.

6. **Microbiologic Assay: Microorganisms in Research and Test Procedures.** Program of Society for Industrial Microbiology. Arranged by Walter N. Ezekiel, Bureau of Ordnance, U. S. Department of the Navy.

Thursday, Dec. 27, Benjamin M. Duggar, Lederle Laboratories Division, American Cyanamid Company, presiding. Speakers: B. M. Duggar; Robert A. Steinberg, U. S. Department of Agriculture, Beltsville, Md.; Lemuel D. Wright, Sharpe & Dohme, Inc., West Point, Pa.; Max S. Dunn, University of California, Los Angeles; H. B. Woodruff, Merck & Co., Inc., Rahway, N. J.; James G. Horsfall, Connecticut Agricultural Experiment Station, New Haven; S. Rich, Connecticut Agricultural Experiment Station; W. L. White, Farlow Herbarium, Harvard University.

News and Notes

Sixth Calorimetry Conference

THE Pupin Physics Laboratory of Columbia University was the meeting place of the Sixth Calorimetry Conference on Sept. 5. The morning and afternoon sessions were attended by approximately 60 individuals representing academic, industrial, and governmental laboratories in North America and Europe. Greetings from the Columbia faculty were presented by H. A. Boorse, who also described some low temperature work on the heat capacity of niobium in both the normal and superconducting states recently completed the Pupin Laboratory.

Donald H. Andrews, in discussing the future of calorimetry, pointed out that, as the concept of entropy becomes more widespread, it is penetrating other fields not involving heat. This has led to the development of the new field of cybernetics which, in its turn, will have an important bearing on calorimetry. Premelting heat capacities are destined to become a powerful tool in purity tests. Accurate liquid heat capacities will furnish the base upon which an adequate theory of the liquid state can be built. More accurate gaseous heat capacity data will assist greatly in mapping the potential field of atoms.

Joseph F. Masi, of the National Bureau of Standards, discussed the adiabatic constant flow calorimetry of gases and remarked that gaseous heat capacities measured with an accuracy of 0.1% are more reliable than those calculated from molecular constants, and can be used to pin down molecular structure and frequency assignments. The accuracy of flow calorimeters was treated by Guy Waddington, of the U. S. Bureau of Mines, who described the Callendar and Barnes type of flow calorimeter in use at the Bartlesville, Oklahoma, laboratory.

At previous meetings of the Calorimetry Conference, three substances—normal heptane, benzoic acid, and synthetic sapphire—were selected as standards for the intercomparison of precision heat capacity calorimeters. The National Bureau of Standards undertook the task of preparation and distribution of the standards, as well as evaluation of the data obtained with them. George T. Furukawa reported on the measurement of heat capacities of these materials and compared them with available data. The benzoic acid has a purity (determined from its freezing point curve) of 99.997 mole %, and the normal heptane purity is 99.999 mole %. Since benzoic acid is corrosive at the higher temperatures, it is not a suitable standard above 350° K. Measurements on the synthetic sapphire have been made up to 900° C. These materials will be issued without charge by NBS to any reputable laboratory agreeing to report the results of their measurements in full to the bureau. Requests for samples should be made to G. T. Furukawa, National Bureau of Standards, Washington 25, D. C.

G. R. Grove read a paper by J. R. Parks describing a group effort of the Mound Laboratory which dealt with bath control, thermal noise, and stability of a twin bridge calorimeter. This work is a part of their calorimetric research program centered around the problem of determining those factors that limit the precise determination of a small amount of power, of the order of 0.01 cal/hr. A detailed mathematical study of bath control from the standpoint of servomechanism theory disclosed that Newton's law of heating and cooling fits the data very well for the unsteady state behavior of the equipment. "Noise" in the bath was of a statistical character and paralleled closely the Langevin analysis of Brownian motion.

The thermochemistry of the alkali and alkaline earth metals in liquid ammonia was presented by L. V. Coulter, of Boston University. The heats of reaction of lithium, sodium, potassium, and cesium with dilute solutions of ammonium ion were determined in a liquid ammonia calorimeter at – 33° C. The data have permitted calculation of monovalent heats of ionization of these elements and result in values in the vicinity of 40.4 Kcal liberated per gram atom of metal. The magnetic properties of dilute metal solutions indicate that an absorption of energy should accompany dilution, presumably resulting from the uncoupling of electron spins. From differences of the heat of solution of potassium at high dilution this effect has been observed and appears to be approaching 3–4 Kcal per gram atom of metal.

E. E. McCoy, Jr., of the U. S. Waterways Experiment Station, Corps of Engineers, U. S. Army, described the practice of calorimetry in the concrete laboratory. During the setting of concrete, 70–80 cal of heat are released for each gram of Portland cement in the mixture. This causes a temperature rise which, if excessive, leads to crack development in the structure upon cooling. Methods were described for the measurement of temperature rise, thermal diffusivity, heat of hydration, and specific heat. These thermal data provide a sound factual basis for the improvement of concrete structures.

The practice of low temperature calorimetry in the Collins cryostat was related by R. S. Craig, of the University of Pittsburgh, and the low temperature heat capacity of lead sulfate was reported by George T. Armstrong. The heat capacity of lead sulfate was measured from 11° to 21° K and observed from 21° to 54° K. The entropy calculated from the new data is about 1.25 eu greater than the literature values. It was pointed out that there is a definite need for data below 50° K for substances that still have a large heat capacity at 50° K. Edgar F. Westrum, Jr., of the University of Michigan, reported on the low temperature calorimetry of thorium dioxide. This work was a joint project with Darrell W. Osborne, of the Argonne National Laboratory. The heat capacity of ThO_2 comes entirely from the lattice vibrations. By assuming that the lattice vibrations of uranium dioxide and neptu-

nium dioxide are the same as thorium dioxide, the electronic contributions to the entropy can be obtained for these oxides by subtraction.

The use of carbon-composition resistors as thermometers in low temperature calorimetry was described by Ellsworth H. Quinnell, of the Naval Research Laboratory. The need for more and better calibration standards was pointed up by Charles E. Messer, of Tufts College, who recommended that a series of high purity organic liquids be made available whose freezing points would be spaced at temperature intervals of 15°–25° over the range from 90° to 300° K. R. Mayer, of Brown Instrument Division of Minneapolis-Honeywell Regulator Co., told the group of a special thermocouple recorder the company had developed in cooperation with H. L. Johnston, of Ohio State University. The instrument was designed for the temperature range −240° to −260° C. Daniel R. Stull, of the Dow Chemical Co., described an electronic constant voltage generator which is capable of maintaining a voltage across a 100-ohm load constant within ± 0.05%. By the addition of a matching resistance equal to the load, a network is developed which causes constant power (within 0.25%) to be developed in a calorimetric heater, even though the temperature of the heater ranges from −200° to +100° C.

At the afternoon session the proposal of the Division of Physical and Inorganic Chemistry of the American Chemical Society that the Calorimetric Conference operate within the framework of the division was discussed. The group voted to abide by the decision of a committee of three—Edgar F. Westrum, Jr., Edward J. Prosen, and Guy Waddington. The group re-elected Daniel R. Stull chairman, and elected Guy Waddington vice chairman for the coming year. The group further made the vice chairman responsible for the program of the next meeting.

DANIEL R. STULL

The Dow Chemical Company
Midland, Michigan

Scientists in the News

Hugh H. Bennett has been appointed special assistant to the Secretary of Agriculture and will be succeeded by **Robert M. Salter** as chief of the Soil Conservation Service. **A. H. Moseman,** assistant chief of the Bureau of Plant Industry, Soils, and Agricultural Engineering, was appointed to fill Dr. Salter's position as chief of that bureau. In other changes at the Bureau of Plant Industry, **James H. Beattie,** horticulturist, retired after 47 years of service; **Marion C. Goldsworth,** plant pathologist, also retired last month.

Martin J. Buerger, MIT professor of mineralogy and petrography, was awarded the Arthur L. Day medal of the Geological Society of America at its annual meeting in Detroit this month. The medal is a memorial to A. L. Day and is given "in recognition of outstanding contributions in the application of chemistry and physics to the solution of geological problems."

Fred Burggraf, formerly associate director of the Highway Research Board, has been named director, to succeed the late **Roy W. Crum.** Mr. Burggraf's career has included work with the National Bureau of Standards, the Illinois Division of Highways, and the Calcium Chloride Association, and he has been associated with the highway board for 15 years.

Robert Chambers, who has been connected with New York University as research professor of biology, has accepted an invitation to serve as chief research consultant of the Dade County Cancer Institute, Cancer Cytology Center, Miami, of which J. Ernest Ayre, recently of McGill University, is director. The institute research program is affiliated with the Medical Research Foundation of Dade County, Florida. Dr. Chambers expects to spend the summer months as usual at the Marine Biological Laboratory, Woods Hole.

Carl A. Dragstedt, professor and chairman of the Department of Pharmacology at Northwestern University's Medical School, has been elected president of the Society for Experimental Biology and Medicine.

At a recent meeting of the directors of the Cenco Corporation and the Central Scientific Company, **John T. Gossett,** president of Central Scientific Company, was elected chairman of the Board of Directors of both companies, succeeding to the responsibilities of the late chairman, **E. Perry Holder.**

Ezer Griffiths, a principal scientific officer at the National Physical Laboratory, has been elected president of the General Conference, the governing body of the Institut International du Froid, at the eighth International Congress of Refrigeration, which was held in London in September.

The Zoology Department of Howard University has announced the promotion of **Louis A. Hansborough** to the rank of full professor and the appointment of **Harry Y. C. Wong** as instructor in zoology. Dr. Wong replaces **Margaret James Collins,** who recently resigned to accept a position at Florida A & M College.

William Rust Neville, Jr., professor of pharmacy, College of Pharmacy, University of Texas, has been placed on modified service beginning this fall. Following 27 years of teaching, Professor Neville's new status was mandatory at the age of 70 years.

L. B. Parsons has been made director of research and development for Lever Brothers Company. Dr. Parsons joined Lever Brothers as a research supervisor in 1939 and was assistant director of research and development when promoted to his new rank.

Linus Pauling, of Caltech, has been selected as the first recipient of the Gilbert Newton Lewis Medal of the California Section of the American Chemical Society. The award, which commemorates the late Professor Lewis of the University of California, is to be presented only to chemists who have made significant contributions to the theoretical aspects of chemistry, and is limited to residents of North America. The section

also will award its first California Section Medal to **C. H. Li,** of the University of California. This medal is to be presented annually to a scientist under 40 years of age who has made a major contribution to chemistry while a resident of one of the eleven Western states. The two awards were established by the section in celebration of its Golden Anniversary.

Walter P. Schreiber, wartime chief of medical science in the Supreme Command of the Wehrmacht, has been assigned to the Department of Global Preventive Medicine at Air Force School of Aviation Medicine, Randolf Field, Texas. A native of Berlin, Dr. Schreiber graduated as a doctor of medicine at the University of Greifswald in 1920, with postgraduate training at the Berlin Academy of Social Medicine and Hygiene. At the outbreak of World War II he was serving the Supreme Command as chief of hygiene. In 1942, he took charge of the department of medical science and was assigned as chief of the scientific department at the Military Medical Academy. In April 1945, he was made a prisoner as the Red Army rolled into Berlin. Taken to East Germany late in 1948, Dr. Schreiber was able to elude his captors and escaped to the American Zone. For the past three years the one-time German general has served as surgeon in an American DP camp.

Robert O. Shaffer, who has been an assistant to the dean of men, has been made assistant to the president of Cornell University. He was with the Cornell Guidance Center as an appraiser for 18 months before joining the office of the dean of men in February 1949.

Lucille S. Spalding, assistant professor in charge of the graduate nurse education program at Washington University School of Nursing since 1946, has been appointed director of Nursing Service in the University of North Carolina Teaching Hospital and associate professor of nursing in the Nursing School.

Elvin C. Stakman, chief of the plant pathology and botany division of the University of Minnesota and former president of the AAAS, has been named winner of the 1951 national Gamma Sigma Delta award for distinguished service to agriculture. The Minnesota scientist was selected for his outstanding research, training he has given graduate students, and his service to the U. S. and many foreign countries as an adviser on agricultural problems.

Charles Scotte Stephenson (USN, Ret.) has been named ninth recipient of the Gorgas Medal presented annually by Wyeth Incorporated to a doctor in the armed forces who has distinguished himself by his contribution to military medicine. The presentation was made at the annual dinner meeting of the Association of Military Surgeons of the United States. The award was established by the Philadelphia pharmaceutical concern in 1942 in memory of Surgeon General William Crawford Gorgas.

W. H. Thorpe, of Cambridge University, will give the Prather Lectures in Biology at Harvard on the theme "Instinct and Learning in the Organization of Animal Behavior." Lectures will be held in the Biological Laboratories on Nov. 30 and on Dec. 3, 5, 7, and 10.

Deane R. White, research director, Technical Division, du Pont Photo Products Department, Parlin, N. J., has been named chairman of Sectional Committee on Motion Pictures PH22 of the American Standards Association. He replaces former chairman **J. A. Maurer,** who has resigned to devote more time to development work within his own company. **Ray L. Garman,** director of research, General Precision Laboratory, Pleasantville, N. Y., has been appointed delegate to the Photographic Correlating Committee of ASA, replacing **C. R. Keith,** Bell Telephone Laboratories, who has resigned to concentrate on other laboratory activities.

Education

University of Pennsylvania medical students are now being trained under a comprehensive new program of teaching, training, and actual field experience. The plan, which is mandatory, requires the first-year student to assume gradually increasing responsibility for the medical and related problems of a family assigned to him, which he follows in clinic, hospital, and home for four years. Other features are participation in public health services and the requirement that all students take up some type of medical work during the summer between the third and fourth years. Greatest emphasis is put upon preventive medicine.

The **Rancho Santa Ana Botanic Garden,** of Anaheim, Calif., has become affiliated with the Associated Colleges at Claremont. The herbarium and portions of the botanical library of Pomona College will be combined with, and housed in, the administration building of the Garden, and members of the Garden staff will offer courses in the Claremont Graduate School. The Garden has been laid out on an 80-acre tract near Claremont. The new mailing address is 1500 N. College Ave., Claremont.

Saint Louis University, the first institution of higher learning in the world to establish a Department of Geophysics, has had its curriculum in geophysical engineering accredited by the Engineer's Council for Professional Development, the intersociety, intraprofessional body that acts as the agent of all the engineering societies of the U. S. and Canada.

Among guest lecturers at the **University of Texas** Medical Branch, Galveston, during November, will be H. Munro Fox, of the University of London, president of the International Union of Biological Sciences, and Kenneth J. Franklin, professor of physiology, University of London, and visiting professor at the University of Illinois. The Medical Branch will offer a pediatric refresher course Nov. 26–30, under the direction of Arild Hansen. Guest speakers will include Charles Chapple, Russell J. Blattner, Gilbert B. Forbes, and S. Howell Wright.

In the Laboratories

Brookhaven National Laboratory has begun the construction of the second unit of its biology laboratory building, which will make available additional research facilities using radiation and radioisotopes in the study of life processes. The new laboratory, scheduled for completion next fall, will house seven standard laboratories, one each for animal physiology, biochemistry, and biophysics, and others for special activities.

The Public Health Service Division of Industrial Hygiene has been renamed the **Division of Occupational Health** and has broadened its activities to include investigations of health hazards in the production, processing, and handling of radioactive materials and radiation-producing processes. The division is preparing to make additional intensive studies of the health requirements of special occupational groups and all problems affecting the health of workers. The program is under the direction of Seward E. Miller, recently appointed division chief.

An **Environment Laboratory** was opened on Nov. 1 in Cleveland, Ohio, by the American Society of Heating and Ventilating Engineers at its Euclid Avenue Research Laboratory. Research will be conducted on heat transfer and distribution in panel heating and cooling systems, comfort conditions, and controls.

The **M. Theodore Kearney Foundation of Soil Science** has been established at the University of California in its College of Agriculture. Through funds bequeathed by Mr. Kearney, the foundation will study soil-water-plant relations through basic research, with particular reference to arid and semiarid farming regions.

Lederle Laboratories has made a research grant of $8,000 to the University of Pennsylvania for the investigation of side effects recently observed in patients to whom new antibiotic drugs, including aureomycin, chloromycetin, and terramycin, have been administered. The funds will be utilized in the Department of Dermatology and Syphilology under the direction of Albert M. Kligman, mycologist.

A new international company, **Minnesota Mining and Manufacturing International Company,** has named Robert W. Young president. He had been president of the Durex companies, through which MM & M formerly engaged in foreign commerce. The new company will operate sales forces and production plants in Europe and South America.

Monsanto Chemical Company has reactivated a program that will permit university and college faculty members in chemical engineering to receive a full year's on-the-job training in industry. This is the reverse of the Monsanto plan for leaves of absence for academic purposes. George M. Machwart, professor of chemical engineering at Michigan College of Mining and Technology, is the first professor selected in the continuation of the program. He will work in the Phosphate Division, Anniston, Ala.

Phillips Petroleum Company has won the 1951 Award for Chemical Engineering Achievement, given by *Chemical Engineering*. Presentation will take place on Nov. 28 during the Chemical Exposition in New York. Commercial development since 1948 of high-abrasion carbon black and major contributions to the successful development of cold rubber won the award for Phillips.

Sterling-Winthrop Research Institute has appointed Wilfred J. Baranick and Edwin L. Smith as research assistants in chemistry, and Theodore G. Brown, Jr., as research assistant in pharmacology.

NSF Program

The $3,500,000 appropriation for the **National Science Foundation** in the Supplementary Appropriation Act of 1952 will enable the foundation to start immediately on its two major operating programs: support of basic research in the sciences and training of scientific manpower. The reduction in the appropriation from the budget request of $14,000,000 has required material scaling down of the program originally presented to the Congress. Approximately $1,500,000 of the available funds will be allocated for the support of basic research in biology, medicine, mathematics, the physical sciences, and engineering; about $1,350,000 for the training of scientific manpower; and the balance for development of a national policy for the promotion of basic research and education in the sciences, for the wider dissemination of scientific information, and for other services, including support of the National Scientific Register, now established in the Office of Education.

Proposals for research grants will be given preliminary evaluation and review by the foundation's three research divisions: the Division of Biological Sciences under John Field, the Division of Mathematical, Physical, and Engineering Sciences under Paul Klopsteg, and the Division of Medical Research under John Field (acting). Each division will be assisted in evaluation and review by a Divisional Committee and by expert consultants. Grants will be approved by the director and the 24-member National Science Board.

The graduate fellowship program will be directed by the Division of Scientific Personnel and Education under Harry C. Kelly. Selection of fellows will be made solely on the basis of ability and will be carried on by the National Research Council. Applications will be considered from students in the natural sciences who have or will have completed their undergraduate work in any accredited college or university. Fellows may attend any accredited nonprofit institution offering graduate studies in science which approves their application for admission. Announcements regarding the National Science Foundation Graduate Fellowships will be distributed within the next week or two. These will describe stipends and allowances in detail. Inquiries and applications should be addressed to the Fellowship Office, National Research Council, Washington 25, D. C.

What GENERAL ELECTRIC People Are Saying

L. L. GERMAN

Knolls Atomic Power Laboratory

RADIATION MONITORING: To illustrate the radiological aspects of civil defense according to air and surface types of atomic explosions, I would like to present a system of radiation monitoring which has been worked out by a group in Schenectady for use principally within the first hour after the explosion. Undoubtedly, many effective systems of this nature have been developed throughout the country.

For both types of explosion, it will be necessary to determine the location of the center of the explosion. This task can be accomplished by the use of simple units called "lampshades" so named because of the shape. The metal lampshade functions on the effect of shadows created by the generated heat and light at the time of the explosion. Mounted at various locations around the target area, so that there will be at least 4 units within five to ten thousand feet from a burst any place within the target area, a shadow will be cast on the inside painted surface of the lampshade at the time of explosion. Wardens will be assigned to read these units, and should two or more wardens report direction and altitude angle, the headquarters unit can then determine ground zero and the height of the explosion. Since the position of the bomb explosion can be fairly well defined by a minimum of two of these units, considerable information is supplied quickly by available and simple facilities. The distance at which the explosion occurred from the warden observing the lampshade can be determined roughly by his noting the length of time between either the flash or shock short wave and the explosion force.

The radiation measurements required for both types of explosions are determined by simple ionization chambers strategically placed throughout the city so as to surround the potential target area. The ideal system would consist of a placement of these chambers on a grid system separated by approximately 1500 feet.

Civil Defense Communications Conference
Syracuse, New York
September 13, 1951

C. E. EGELER

R. F. VANDEN BOOM

Lamp Division

LIGHTING MAINTENANCE: Illuminating engineers, and to a lesser extent, consumers of light in industry, have long realized the gradual but serious cumulative loss in illumination resulting from dirt on lamps and reflectors. Most manufacturers simply are not aware that where there is no regular cleaning, the light loss may be as much as 50 per cent. This is no doubt due in part to the paucity of actual test data regarding the rate of depreciation in lighting levels which occurs under various service conditions and to the limited dissemination of such information as is available.

The operating cost of a lighting system always involves energy, lamp and lamp replacement (labor) costs. In a typical medium-sized plant using two-lamp 40-watt fluorescent industrial units, with energy at 1½ cents per kw-hr, 85 cent net lamp cost, a 50 cent cost of random lamp replacement and 4500 burning hours per year, the over-all annual operating cost excluding investment amortization is $8.10 per 2-lamp luminaire. Two cleanings per year will provide a 42 per cent increase in illumination, or $3.40 worth of light. For a given average illumination the required investment will likewise be substantially reduced. Even though this investment factor be ignored, any cleaning cost up to $1.70 per fixture pays a real dividend. With systematic maintenance a two-lamp 40-watt fluorescent unit usually can be cleaned for about 35 cents.

Defense mobilization imposes on industry an imperative responsibility for the most effective use of production facilities and manpower. Good lighting becomes more vital than ever, particularly when it is remembered that in the increment of needed workers there will be a greater proportion of older people who need the higher illumination levels to compensate for impairment of vision and age.

National Technical Conference of the
Illuminating Engineering Society
Washington, D. C.
August 27-30, 1951

Meetings & Conferences

Nov. 22–24. Central Association of Science and Mathematics Teachers (Annual). Hollenden Hotel, Cleveland.

Nov. 23–24. American Mathematical Society. Alabama Polytechnic Institute, Auburn.

Nov. 23–24. American Mathematical Society. University of Oklahoma, Norman.

Nov. 25–Dec. 1. Congrès International de Chimie Industrielle. Paris.

Nov. 26–30. American Society of Mechanical Engineers (Annual). Chalfonte-Haddon Hall, Atlantic City.

Nov. 26–30. Institute on Administration of Scientific Research and Development (sponsored by AAAS and National Research Council). American University, Washington, D. C.

Nov. 26–Dec. 1. Exposition of Chemical Industries. Grand Central Palace, New York.

Nov. 27–28. American Institute of Architects and Atomic Energy Commission Conference on Laboratory Design for Handling Radioactive Materials. National Academy of Sciences, Washington.

Nov. 28–30. Scientific Apparatus Makers Association (Midyear). Hotel New Yorker, New York.

Nov. 28–30. Western Forestry and Conservation Association (Annual). Multnomah Hotel, Portland, Ore.

Nov. 29–30. Animal Care Panel. Northwestern University, Chicago.

Nov. 29–30. Pittsburgh Diffraction Conference (Annual). Mellon Institute, Pittsburgh.

Nov. 30. Scientific Research Society of America (RESA). National Academy of Sciences, Washington, D. C.

Nov. 30–Dec. 1. American Physical Society. Rice Institute, Houston.

Dec. 1. American Mathematical Society. California Institute of Technology, Pasadena.

Dec. 2. American Academy of Dental Medicine (Midwinter). Hotel Statler, New York.

Dec. 2–3. American College of Chest Physicians (Interim Session). Ambassador Hotel, Los Angeles.

Dec. 2–5. American Institute of Chemical Engineers (Annual). Chalfonte-Haddon Hall, Atlantic City.

Dec. 2–5. American Society of Refrigerating Engineers (Annual). Hotel Roosevelt, New York.

Dec. 2–5. Vegetable Growers Association of America (Annual). Marlborough-Blenheim Hotel, Atlantic City.

Dec. 5–8. Philippine College of Surgeons (Annual). Philippine General Hospital, Manila.

Dec. 6. American Psychoanalytic Association (Midwinter). Hotel Waldorf-Astoria, New York.

Dec. 6. Society of Cosmetic Chemists (Annual). Biltmore Hotel, New York.

Dec. 6–8. American Chemical Society (Southwest Regional). Austin, Texas.

Dec. 7–8. Way of Science Conference (Annual). Roosevelt College, Chicago.

Dec. 9–13. Entomological Society of America, American Phytopathological Society, and the Potato Association. Netherland Plaza Hotel, Cincinnati.

Dec. 10–11. Southern Psychiatric Association (Annual). Carolina Inn, Pinehurst, N. C.

Dec. 11–19. International Congress on Mental Health. Mexico City, D. F.

Dec. 14–15. Association for Research in Nervous and Mental Disease. Roosevelt Hotel, New York.

Dec. 20. American Society of Perfumers. Advertising Club, New York.

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 15¢ per word, minimum charge $3.00. Use of Box Number counts as 10 additional words.

DISPLAY: $17.50 per inch, no charge for Box Number.

Correct payment to SCIENCE must accompany all ads. Insertion usually made 2 or 3 weeks after receipt of ad.

SCIENCE • 1515 Mass. Ave., N.W., Wash. 5, D. C.

POSITIONS WANTED

Biochemist: Ph.D., outstanding record of original research in nutritional biochemistry; administrative and teaching experience; age 37. East or West coast preferred. Box 35, SCIENCE. X

Position Wanted:
Biochemist; Ph.D.; since 1945, director development and distributor of plasma and liver fractions, pituitary factors for animal experimentation, purified enzymes; broad experience in research; for further information, please write Science Division, Medical Bureau, (Burneice Larson, Director) Palmolive Building, Chicago. X

Pharmacologist-Chemotherapist, M.D., Ph.D. with broad scientific and industrial experience, now in responsible position, soon available as department head, research director or equivalent. Box 24, SCIENCE. 11/16

POSITIONS OPEN

Biochemist—Ph.D. with experience in basic research on intermediary metabolism. Background in enzymes and organic chemistry essential. Drug industry, Central New York State. Box 29, SCIENCE. 11/30

BIOCHEMIST, Ph.D.

- Attractive research position in Division of Biochemistry of **Pharmaceutical Company** expanding research activities. Location, Central New Jersey.
- Background in physical chemistry and in vitro metabolism studies desirable. Please give details of education and references. Box 30, SCIENCE.

Botanist: Position in fiber microscopy, plant anatomy for girl with B.S. Degree. Excellent laboratory facilities. Located in Wisconsin. Box 36, SCIENCE. 11/23

Chemist: Ph.D. or equivalent, for research project in protein chemistry of connective tissue. Large research institution, New York City. About $5000. Box 37, SCIENCE. X

COIL ENGINEER
urgently needed

Must have experience in all phases of manufacturing IF and RF coils and permability tuners. Electrical engineer or equivalent desired. Knowledge of methods and processing is essential. Unusual opportunities to grow in a new section of an established highly regarded electronic manufacturing company. Write Box 31.

Are YOU seeking . . .

a new position, or new personnel?

41 **replies received from ONE classified ad in SCIENCE . . . Your ad here will get results!**

Send your ad NOW!

POSITIONS OPEN

Physicist to do research and development work on silicones and fluorinated polymers. Give education, personal data, photograph, salary requirements in letter of application. The Connecticut Hard Rubber Company, Attention: TS, 407 East Street, New Haven, Connecticut. 12/7

Research Assistant, full-time, B.S. or M.S. Bacterial metabolism; experience with Warburg techniques and background in general chemistry desirable. Biology Department, Wesleyan University, Middletown, Conn. 11/23

Positions Open:
(a) Histopathologist; preferably experienced in research on tumor pathology; research post; agricultural college; South; $8000. **(b) Biochemist;** research appointment in industry; Chicago. **(c) Radiation Biologist;** Doctor's degree preferred, Master's degree eligible; should have knowledge of production, physics, biological effects of alpha particles; West; $5000. **(d) Organic Chemist** qualified pharmaceutical chemistry; key appointment with new products division, one of major chemical companies; Midwest. **(e) Clinical Psychologist;** newly established mental hygiene clinic, well supervised; college town, Northwest. **(f) Ph.D.,** pharmacology or physiological chemistry with considerable experience in pharmacological field, to serve as technical service representative; large company; Midwest. **(e) Assistant Medical Director;** one of major pharmaceutical companies; should be interested clinical testing, industrial medicine, serving as consultant; East. S11-3 Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

SCIENTISTS—salaried positions, $3,600 to $25,000. This confidential service for outstanding men who desire a change of connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. **TOMSETT ASSOCIATES** • 335 Frick Bldg., Pittsburgh 19, Pa.

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 20¢ per word, minimum charge $5.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	**$17.50 per inch**
7 times in 1 year	**16.00 per inch**
13 times in 1 year	**14.00 per inch**
26 times in 1 year	**12.50 per inch**
52 times in 1 year	**11.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS

BACK NUMBER PERIODICALS — Bought and Sold
• Tell us what you want!—What have you to offer?
Abrahams Magazine Service Established 1889 ▶ DEPT. P, 56 E. 13th ST. NEW YORK 3, N. Y.

Your sets and files of scientific journals are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

LOOK AROUND... notice the increasing number of satisfied advertisers using small-space ads regularly in practically every issue of SCIENCE—*proof that these small ads get results!* If you have a product or service of interest to scientists, why not take advantage of this low-cost means of increasing your profits!

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 20¢ per word, minimum charge $5.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	**$17.50 per inch**
7 times in 1 year	**16.00 per inch**
13 times in 1 year	**14.00 per inch**
26 times in 1 year	**12.50 per inch**
52 times in 1 year	**11.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS

SCIENTIFIC BOOKS and PERIODICALS WANTED
Complete libraries—Sets and runs—Single titles
Also, please send us your want lists.
STECHERT-HAFNER, INC.
31 East 10th St., New York 3

WANTED TO PURCHASE . . .
SCIENTIFIC PERIODICALS and BOOKS
Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.
WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

YOU reach over 32,000 scientists in these columns—at a very low cost

PROFESSIONAL SERVICES

SINCE 1870

New Food Ingredients • New Drugs
ANIMAL TESTS
Analyses • Consultation • Research
LaWall & Harrisson
Bacteriologists
Chemists • Pharmacologists
Div. S, 1921 Walnut St., Philadelphia 3, Pa.

SUPPLIES AND EQUIPMENT

SODIUM IODIDE, THALLIUM-ACTIVATED CRYSTALS
Vacuum-sealed in quartz envelopes to insure permanency. Designed for scintillation work with standard photomultiplier tubes. Write for Bulletin SC-5. NUCLEAR RESEARCH CORP. 2707 Federal Street, Philadelphia 46, Pa. H

STAINS
STARKMAN Biological Laboratory
• RARE
• COMMON
Price list on Request
• 461 Bloor St., W. Toronto, Canada

FOR UNIFORM RESULTS
Eliminate the nutrition variable in your work with lab animals. Use Purina Laboratory Chow for uniform results.
RALSTON PURINA COMPANY
St. Louis 2, Mo.

SUPPLIES AND EQUIPMENT

FREE CATALOG No. 677..
Lists more than 300 items for Research—Biological, Microbiological, Bacteriological, Biochemical, Nutritional. Write

GBI 72 LABORATORY PARK CHAGRIN FALLS, OHIO

All Amino Acids (natural, synthetic, unnatural), Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.
BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.

For CONSISTENT Rats . . .
• *BUDD MT. RODENT FARM*
• *CHESTER, N. J.*
Breeders of a recognized strain of Wistar.

PARASITOLOGICAL PREPARATIONS
• high quality — low priced. *Write for catalog*
TROPICAL BIOLOGICALS • P.O. Box 2227, San Juan, Puerto Rico.

it pays to advertise in SCIENCE . . .
". . . the results from our advertising in your medium . . . have been too much for our staff to handle and we must halt so we may catch our breath.
"As soon as we catch up with our work, you can rest assured that we will be back in your extremely productive periodical."
Name on request
try it—and you'll agree • See Charges and Requirements

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 20¢ per word, minimum charge $5.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	**$17.50 per inch**
7 times in 1 year	**16.00 per inch**
13 times in 1 year	**14.00 per inch**
26 times in 1 year	**12.50 per inch**
52 times in 1 year	**11.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

SUPPLIES AND EQUIPMENT

ANIMAL CAGES AND ACCESSORY EQUIPMENT

BUY DIRECT FROM MANUFACTURER

HOELTGE BROS., Inc.

1919 Gest St. Cincinnati 4, Ohio

Write for Illustrated Catalog

LABORATORY ANIMALS

● Clean healthy well-fed animals Guaranteed suitable for your needs.

Reasonably priced—Dependable service

DOGS CATS MICE RATS PIGEONS POULTRY RABBITS HAMSTERS GUINEA PIGS

JOHN C. LANDIS • Hagerstown, Md.

SUPPLIES AND EQUIPMENT

MICRO BEAKERS

WRITE FOR LEAFLET MB-S

R. P. CARGILLE 118 Liberty St. New York 6, N. Y.

L-PROLINE—Hydroxyproline, L-Methionine

● AMINO ACIDS ● BIOCHEMICALS

● PRE-MIXED MICROBIOLOGICAL ASSAY MEDIA

H. M. CHEMICAL COMPANY, LTD.

144 North Hayworth Avenue Los Angeles 48, California

Entries in the **Fifth International Photography-in-Science Salon,** sponsored annually by THE SCIENTIFIC MONTHLY and the Smithsonian Institution, should be sent (prepaid) to the Editor, *The Scientific Monthly,* 1515 Massachusetts Ave., N.W., Washington 5, D. C., Nov. 1–Nov. 27. All accepted photographs will be shown at the AAAS meeting in Philadelphia Dec. 26–31, and later throughout the U. S. For entry blanks and full information write to the address given above.

KLETT ELECTROPHORESIS

CUSTOM MADE

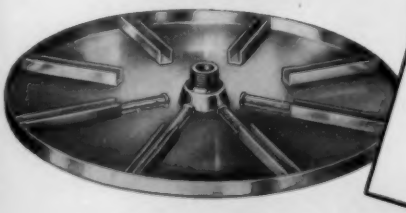
TOOL FOR THE ANALYSIS OF COMPLEX COLLOID SYSTEMS, AND FOR THE CONTROL OF PRODUCTION OF PURIFIED PROTEINS, ENZYMES, HORMONES

KLETT MANUFACTURING CO.
179 EAST 87TH STREET
NEW YORK, N. Y.

New High Speed Accessories
for HEMATOCRIT DETERMINATIONS

For the International Clinical Model Centrifuge — a new bronze shield, No. 301. This shield holds the standard Wintrobe tube and fits the regular horizontal type heads, No. 213, 4-place, and No. 214, 2-place. Smaller diameter of the shield permits higher speed, 3850 r.p.m. on alternating current. In these heads, the shields revolve at 90° to the vertical axis, resulting in a meniscus parallel to the glass tube graduations, facilitating faster, more accurate reading.

No. 213, 4-place head with 4 No. 301 metal shields



No. 289, 8-place head and cover

For all International Size 1 and Size 2 Centrifuges — a new high-speed disc type head and cover No. 289. Accommodates 8 Wintrobe hematocrit tubes and spins them in a flat plane at 90° to the vertical axis at 4500 r.p.m. The high centrifugal force (3190 x gravity at the tips of the whirling glass tubes) results in maximum packing of the cells, and the meniscus parallel to graduations insures faster, more accurate reading. Separate metal shields not required.

Available promptly from your Laboratory Apparatus Dealer.

INTERNATIONAL EQUIPMENT COMPANY

1284 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

MEET THE NEW POLARIZING MICROSCOPE

Everyone Can Afford

- STANDARD STRAIN-FREE OBJECTIVES AND EYEPIECES
- SIMPLE GRADUATED ROTATABLE STAGE
- PINHOLE OR TELESCOPIC EYEPIECE FOR VIEWING INTERFERENCE FIGURES
- BUILT-IN ILLUMINATION WITH DISC DIAPHRAGM APERTURE CONTROL

CRYSTALLOGRAPHERS, chemists, petrologists . . . here is the laboratory and teaching instrument you have been looking for. It's the AO Spencer P45 Microscope, suitable for powers up to 430X, numeral apertures up to 0.66. The built-in polarizer and removable body tube analyzer are of *precision* optical-quality polaroid. All standard AO compensators are accommodated.

Although simplified in construction and operation, the P45 retains highest-quality AO Spencer optical and mechanical features throughout. See it at your first opportunity. You'll be amazed at the price—a fraction of the amount you would expect to pay. For further information, write Dept. Y3.

American Optical

INSTRUMENT DIVISION • BUFFALO 15, NEW YORK